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Relationship Between Trait Anxiety, State Anxiety and Awareness in Processing of Threat

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Declaration of Originality

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy. This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

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Date: 6 July 2015

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Abstract

In five experiments, interference paradigms were employed to investigate the role of awareness in determining the automatic nature of attentional biases to threat in anxiety. To investigate whether attentional biases to threat occur outside of conscious awareness, participants were presented with masked and unmasked valanced stimuli. In Experiment 2.2 and 3.2 the presentation of masked and unmasked stimuli was intermixed. To investigate the role of priming in moderating these effects three experiments (Experiment 1, 2.1 and 3.1) blocked on the presentation order of exposure mode such that half of the participants received two blocks of masked trials first followed by two blocks of unmasked trials and half of the participants received the reverse order. In Experiment 1, 2.2 and 3.2, the stimulus onset asynchrony (SOA) between the target and the mask was individually determined during the SOA threshold setting trials, whereas in Experiment 2.1 and 3.1, the SOAs between the target and the mask were set at 15 msec for all participants. SOA of 15 msec was chosen because previous studies have shown that shorter SOAs have demonstrated selective attention for masked face stimuli (e.g., 14 msec & 17 msec, Mogg & Bradley, 1999a, Experiment 1 & Experiment 3, respectively; 14 msec, Mogg et al., 1993a 14 msec, Harvey et al. 1996; 20 msec, MacLeod & Rutherford, 1992). Awareness checks were conducted across all experiments by way of forced-choice decision task and Study 3.1 and 3.2 included a additional digit classification task, to ensure that participants did not become aware of stimuli on masked trials over the course of the experiment. Participants' data was excluded from analysis if they performed above criterion on the awareness check trials.

To investigate the involuntary nature of the automaticity hypothesis, computerized versions of two interference paradigms were employed. On the emotional Stroop colour naming task (Experiment 1, 2.1 and 2.2) the central task and the distracting information were

an integrated feature of the same stimulus, whereas these stimuli were spatially separated on the Flanker task in Experiment 3.1 and 3.2. These paradigms have been shown to be an effective measure for the purpose of this investigation because they allow for competition of attention between two features by asking participants to ignore distracting information while attending to a central task. To investigate selective attention to threat, the following series of studies employed threat-related and neutral words as stimuli in Experiment 1 and emotionally toned schematic faces across four experiments (Experiment 2.1, 2.2, 3.1, 3.2).

To investigate the separate effects of trait and state anxiety in moderating these effects, a sample of non-clinical high-trait anxious (HTA) and low-trait anxious (LTA) individuals was employed across all five experiments. Allocation to trait anxiety group was determined on the basis of questionnaire scores. To extend on previous research, Experiment 1 included a clinically anxious sample for comparison. To investigate the role of state anxiety in moderating attentional allocation to threat, across all experiment, half of the HTA and half of the LTA participants performed under the immediate threat of an electric shock and half performed under shock safe conditions. In Experiment 1, the clinically anxious participants performed under shock safe conditions.

Study 1 employed the emotional Stroop colour naming task. Clinically anxious and non-clinical HTA and LTA participants were presented with threat related and non-threat related words within and outside of conscious awareness. Mode of exposure presentation was blocked so that half the participant received the masked exposure mode first followed by the unmasked exposure mode, whereas others received the opposite exposure order. State anxiety was manipulated by exposing half of the HTA and half of the LTA participants to a threat of shock whereas the remaining half performed without the threat of shock. State anxiety was not manipulated in the clinically anxious group. The results indicated that irrespective of exposure mode, presentation order or shock condition group all participants demonstrated an attentional bias toward threat related words relative to neutral words. These results suggest that priming or awareness of threat is not a necessary precondition to establish effects for verbal materials that are presented using backward masking procedures.

Study 2.1 and Study 2.2 investigated attentional biases for pictorial stimuli using the emotional Stroop colour naming task. In Study 2.1, HTA and LTA participants performed a colour naming task with masked and unmasked angry, happy and neutral schematic faces under shock threat and shock safe conditions. Mode of exposure was blocked so that half the HTA and half of the LTA participant received two blocks of masked trails followed by two blocks of unmasked trials, whereas the other half of each group received the reverse exposure order. The results indicated that irrespective of presentation order, on the unmasked trials there was no difference in RT for threat, happy or neutral schematic faces across participants. On the masked trials, there was no difference in RT for the LTA participants, whereas the HTA participants took longer to colour name threat related relative to happy schematic faces but only while performing in the shock safe condition. These results suggest that HTA participants selectively attend to threat related relative to happy faces but only under stress free conditions. These results further suggest that priming is not a precursor for activating the mechanisms responsible for eliciting attentional biases to threat at preconscious levels. In Study 2.2, participants were presented with an intermixed sequence of masked and unmasked angry, happy and neutral schematic faces while performing under the threat of shock or in the absence of shock. The result failed to reveal any significant effects involving valence of pictorial stimuli. These results suggest that when the presentation of masked and unmasked trials was intermixed, attentional resources were not selectively recruited by either valence category in the HTA or LTA participants.

In Study 3.1 and 3.2 HTA and LTA individuals verbally identified a probe (either triangle or square) that was presented on the left or the right periphery of a computer screen while simultaneously, angry, happy or neutral schematic face pairs were displayed in the upper and lower centre of the computer screen. In Study 3.1 HTA and LTA participants performed the flanker task with masked and unmasked angry, happy and neutral schematic faces under shock threat and shock safe conditions. Mode of exposure was blocked so that half the participant in each trait anxiety group received two block of masked trials followed by two blocks of unmasked trials, whereas the other half of each group received the opposite order. The results indicated that when mode of exposure was blocked, attentional resources were not influenced by the valence of stimuli in either the HTA or LTA participants. In Study 3.2, HTA and LTA participants performed the flanker task under shock threat or shock safe conditions. Angry, happy and neutral face pairs were presented masked and unmasked in an intermixed sequence. On the unmasked trials, the result failed to reveal any differential attentional patterns as a function of valence between the HTA or LTA participants irrespective of shock conditions. On the masked trials, irrespective of trait anxiety group (both HTA and LTA) participants took longer to classify the probe when it was presented along with neutral compared to threat face pairs but only in the shock safe condition. Reaction times to classify the probe when presented with happy face pairs did not differ from either natural or threat stimuli. The results indicated that when mode of exposure was intermixed, there was no difference in threat processing between the HTA and LTA participants.

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Chapter 1

Automaticity of Selective Attention to Threat in Anxiety

Overview

Anxiety disorders are among the most prevalent forms of psychopathology (Kessler, Berglund, Demler, Jin, Merikangas, & Walters, 2005; Kessler, Chiu, Demler, & Walters, 2005). Studies of adult community samples in the Unites States report an estimated 18.1%, 12-month prevalence (Kessler, Chiu et al., 2005) and 28.8 % estimated life prevalence (Kessler Berglund et al., 2005) of any anxiety disorder. Further, a 2007 National Survey of Mental Health and Wellbeing in Australia, reports a 11.8%, 12- month prevalence and 20.0% lifetime prevalence of anxiety disorders (McEvoy, Grove & Slade, 2011). Given that anxious symptomology is associated with significant impairment in overall functioning and reduction in quality of life (American Psychiatric Association, 2013), research into the mechanisms that may underpin anxious pathology and/or maladaptive anxiety states is critical to aid in treatment consideration.

The relationship between attention and anxiety has been investigated over the past 40 years. Empirical findings suggest that anxious individuals selectively attend to emotionally-related stimuli, mainly threat-related, relative to neutral stimuli (for reviews see Bar-Haim, 2007; Cisler, Bacon & Williams, 2009; Cisler & Koster, 2010; Mogg & Bradley, 1998). On the basis of these findings, a number of theoretical models have attempted to explain the possible cognitive mechanisms that may sustain anxious pathology and/or maladaptive anxiety states (e.g., Clark & Beck, 2010; Mogg & Bradley, 1998; Öhman & Mineka, 2001). These theoretical models share two common predictions: (1) anxiety is characterized by an attentional bias favouring threat information and (2) this bias is automatic in that it is involuntary and occurs outside of conscious awareness. Despite these similarities, the models place differential emphasis on the role of trait anxiety (predisposition), state anxiety (current) and awareness in moderating selective attention to threat in anxiety.

However, a number of methodological limitations associated with empirical data that have contributed to the development of these theoretical models have not allowed palpable support for the predictions they make. For example, most masked studies investigating attentional biases for threat outside of conscious awareness were associated with the following methodological limitations: (1) they did not employ individual stimulus onset asynchronies (SOAs) between the presentation of the target and the mask, and; (2) they did not implement a final awareness check procedure. Therefore, it is possible that participants may have become aware of stimuli on masked trials during the course of the experiment. Also, when assessing for masked threat effects, most studies have presented unmasked and masked trials intermixed, allowing for the possibility that unmasked trials may have primed threat responses on the masked trials (e.g., see Fox, 1996).

A further concern for the predictions of these models is that they stem from empirical research that varies on the type of task demands they employed (e.g., visual search task, emotional Stroop colour naming task, dot probe task and other tasks). This can be problematic because different experimental paradigms are likely to measure different cognitive processes (see Chapter 2 for review). Therefore, the interpretational difficulties that arise from these data prove difficult for developing a coherent theory.

A further limitation of previous research is that it is unclear how attentional biases to threat manifest as a function of stressor type. For example, MacLeod and Rutherford (1992) who manipulated state anxiety through examination stress in a sample of students provide data suggesting that attentional biases to threat may operate as a function of gradual, naturalistic stressors. By contrast, only a few studies (e.g., Edwards et al.,2006, 2010a, 2010b; Miller & Patrick, 2000) provide data to also suggest that these effects may be moderated by more short term, immediate and acute stress manipulations (i.e., threat of electric shock). In summary, the central assumptions of the existing models are based on empirical data that are potentially discordant and difficult to interpret. Therefore, in order to accept the assumptions that these models make, research with tight experimental controls is warranted.

Structure of Thesis

The current thesis aims to achieve the following: (1) to investigate differences in attention for verbal threat between clinically anxious and non-clinical, high trait anxious (HTA) and low trait anxious (LTA) individuals; (2) to investigate the separate effects of state and trait anxiety on selective attention for emotional stimuli; (3) to investigate attentional patterns for emotionally toned schematic faces; (4) to investigate the role of awareness in moderating attentional biases for emotionally toned stimuli; (5) to compare responses for spatially integrated vs. spatially separate stimuli; (6) to provide more data for development of theory; (7) to identify limitations of current research and to suggest recommendation for future research and; (8) to provide information that can aid in the treatment considerations of anxiety disorders.

The following section of the current chapter will discuss three prominent theoretical perspectives on attentional biases in anxiety and will conclude with a discussion on the clinical implications derived from the predictions made by the models. In Chapter 2, a review and critical evaluation of the current empirical literature will be discussed and referenced with respect to the theoretical perspectives and will conclude with the limitations that are proposed to be addressed by the current series of studies. Chapter 3 will provide a description of the general methodology employed in the current series of studies (e.g., participants, equipment, psychometric measures and stimuli). Current empirical studies are discussed in Chapter 4, 5 and 6. Chapter 7 includes the general discussion of findings from the present series of studies. The current data is matched to previous findings and theoretical models. This chapter further discusses the limitations associated with the current series of studies, treatment consideration of anxiety disorders and directions for future research.

The central aim of the following studies is to investigate the role of awareness on selective processing of threat in clinically anxious (Chapter 4) and non-clinical, high trait anxious (HTA) and low trait anxious (LTA) individuals (Chapters 4, 5 and 6). Chapter 4 and Chapter 5 employ the emotional Stroop colour naming task whereby the central task and the distracting information are integrated features of the same stimulus. In Chapter 4 (Study 1), to investigate whether priming is necessary to activate selective processing of verbal threat at preattentive levels, blocked presentations of masked and unmasked, threat related and non-threat related verbal stimuli are employed with a sample of clinically anxious and non-clinical HTA and LTA participants. To investigate the role of awareness for pictorial threat, Chapter 5 reports blocked (Study 2.1) and intermixed (Study 2.2) presentations of masked and unmasked emotionally toned schematic faces with a sample of HTA and LTA individuals. Chapter 6 (Study 3.1 and 3.2) employs the Flanker task whereby the central task and distracting information are spatially separated. In this chapter emotionally toned schematic faces are presented blocked on exposure in Study 3.1, and 3.2 employs intermixed masked and unmasked stimuli with a sample of HTA and LTA participants. In all studies, the non-clinical, HTA and LTA participants are subjected to a state anxiety manipulation whereby half of the participants in each trait anxiety group are allocated to a shock safe or shock threat condition. The rationale for each study is described in the corresponding introductory section of each experimental chapter.

Chapter 7 provides a general discussion of the current data with respect to previous empirical findings and theories and concludes with the limitations of the current set of studies, suggestions for future research and treatment considerations. The information obtained in the current studies may have important clinical implications for treatment of anxiety disorders.

Theoretical Perspectives

Cognitive Motivational Model (Mogg & Bradley, 1998)

Mogg and Bradley's (1998) Cognitive Motivational Model (see Figure 1.1) proposes that there are two systems which determine the attentional allocation to threat in anxious individuals. First, incoming information is evaluated for threat value by the *valence evaluation system (VES)*. Stimulus input, situational context, state anxiety, prior learning and biological preparedness will determine the output of this system. The output of the *VES* feeds into the *goal engagement system* (*GES*) that determines the cognitive processes and allocation of attentional resources. If stimuli are evaluated as highly threatening, automatic interruption of current goals and attentional allocation to the source of threat results. However, if the stimulus is evaluated as having low or no threat value, current task goals/activities are pursued free of interruption and low threat stimuli ignored. Further, trait anxiety will influence the *VES* reactivity to threat stimuli. That is, high trait anxious individuals will attend to stimuli that are evaluated as mild or high in threat value, whereas low trait anxious individuals will only attend to stimuli evaluated as high in threat value and ignore mild/ no threat stimuli. Mogg and Bradley suggest that attentional biases to threat occur at an automatic preconscious level. That is, both the *VES* and *GES* systems operate outside of conscious control. Mogg and Bradley also view attentional biases to threat as factors that maintain but not cause anxiety. In sum, Mogg and Bradley's (1998) cognitive motivational model suggests that anxious individuals, compared to their non-anxious counterparts, are more attentive to aversive stimuli compared to non—aversive stimuli and that this attentional bias is automatic in that is involuntary and occurs outside of conscious awareness (see Figure 1.1).

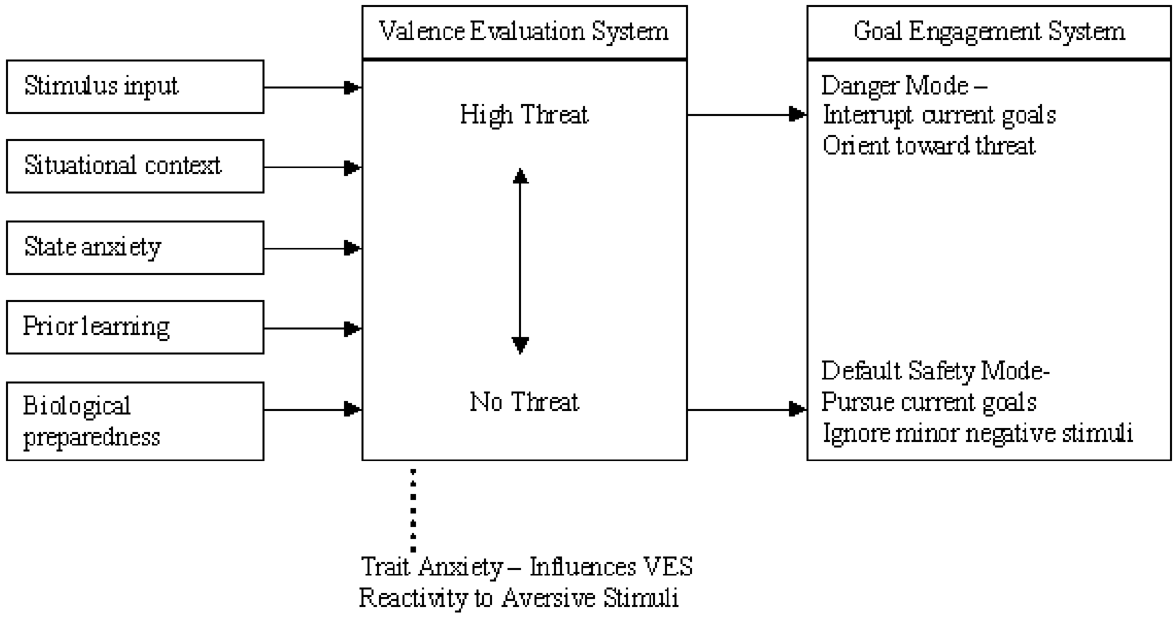

Figure 1.1. Mogg and Bradley (1998) cognitive-motivational model of anxiety representing the factors influencing vigilance or avoidance of threat. (Figure adapted from Mogg & Bradley (1998) a cognitive-motivational analysis of anxiety).

Cognitive Model (Clark & Beck, 2010)

Clark and Beck (2010) propose a schema based cognitive model of anxiety (see figure1.2) that places emphasis on a heightened state of *vulnerability* in activating attentional biases to threat in anxious individuals. The concept of *vulnerability* is defined as "a person's perception of himself as subject to internal or external dangers over which his control is lacking or is insufficient to afford him a sense of safety. In clinical syndromes, the sense of vulnerability is magnified by certain dysfunctional cognitive processes” (Beck, Emery & Greenberg, 1985, pp. 67-68). Therefore, according to this model, anxious individuals possess a heightened vulnerability to demonstrate an exaggerated threat related bias toward neutral or innocuous stimuli, cues or situations.

According to this model, during the *orienting mode*, attention for incoming threat is automatic and preconscious, and results in the automatic activation of the schema driven *primal threat mode*. The *primal threat mode* is a rapid and efficient primary appraisal of threat driven by interrelated schemas essential for the survival and adaptation of organisms by minimising danger and maximising safety. During this stage four additional processes aid in the immediate fear response: *increased autonomic arousal, cognitive processing bias and errors, immediate defensive inhibitory response* and *threat-orientated thoughts and images.* The activation of these processes strengthens the primary threat appraisal. Although mainly automatic, the immediate fear response via the primal threat mode triggers the activation of the more strategic and controlled *secondary elaborative reappraisal* stage. During this stage, five cognitive processes occur: *evaluation of coping resources, search for safety cues, constructive mode thinking, initiation of worry* and *reappraisal of threat.* However, in anxious individuals, once the primal threat mode enables the immediate detection of threat, all strategic and controlled processes are blocked or serve to strengthen the pathological bias toward threat. In sum, Clark and Beck’s (2010) cognitive model suggests that anxious individuals are characterized by automatic selective attention toward threat and that this threat is automatic in that it is involuntary, occurs outside of conscious awareness and is impenetrable to conscious influence (see Figure 1.2).

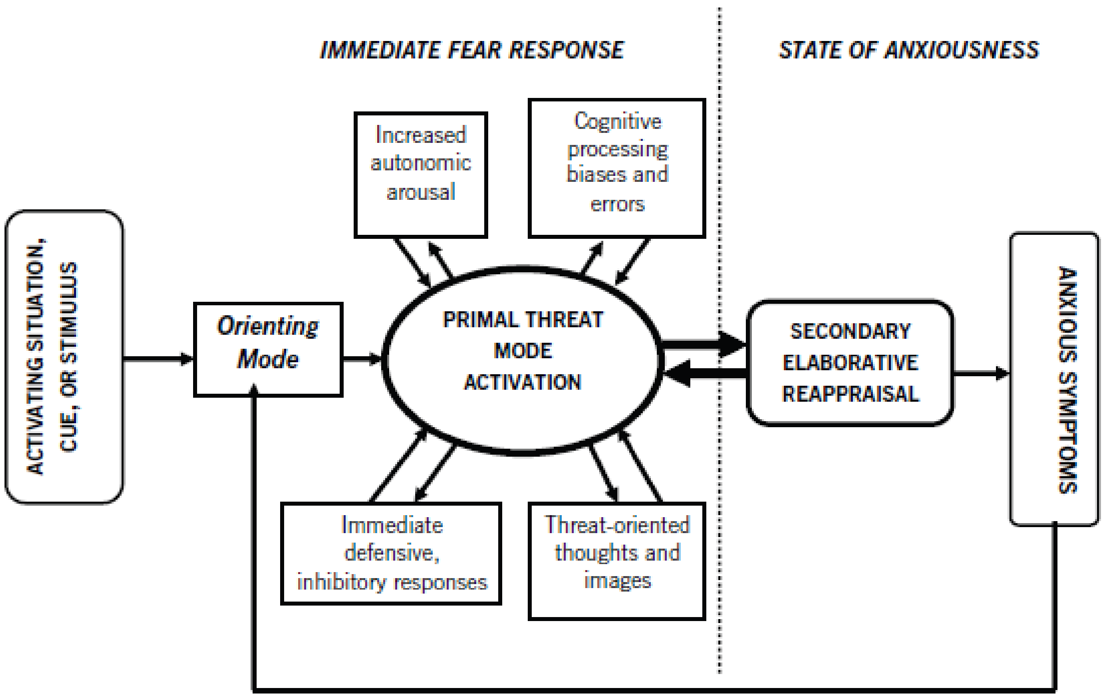

Figure 1.2. Clark and Beck (2010) cognitive model of anxiety. Figure adopted from Clark and Beck (2010), Cognitive Therapy of Anxiety Disorders: Science and Practice.

Evolved Fear Module (Öhman & Mineka, 2001)

Öhman and Mineka's (2001) Evolved Fear Module is an extension of the original Fear Module proposed by Öhman (1993) (see Figure 1.2). This model emphasises the automaticity of attention toward biological threat (e.g., snakes or angry faces) and the activation of fear. This model proposes that *feature detectors* analyse all incoming information for threat value or biological preparedness at very early stages of processing, prior to conscious awareness of stimuli. If the input is evaluated as having high threat value or holding biological or evolutionary relevance, the autonomic *arousal system* is immediately activated by the *feature detectors* resulting in behavioural responses to threat (i.e., directing attention to threat). If at initial registration the input is not evaluated as having biological relevance or high threat value by the *feature detector* system, it is passed on to a non-conscious *significance evaluator* system that is responsible for evaluating the significance of the output from the *feature detector* system . The information is then passed on to the *conscious perceptions system* that engages in a slow and deliberate evaluation of the input along with the meaningful memories stored in the e*xpectancy system.* If after conscious processing danger is perceived or stimuli are evaluated as threatening, the autonomic *arousal system* is activated by way of a slower, more conscious route. The autonomic *arousal* and *expectancy systems* influence the sensitivity of the *significance evaluating system* that primes prompt detection of other incoming stimuli associated with the expected danger. Detection of threat and fear responses is more sensitive in fearful individuals (Öhman, Flykt, & Esteves, 2001).

Öhman and Mineka's (2001) *Evolved Fear Module* (see Figure 1.3) is an extension of Öhman's (1993) *Fear Module* and incorporates four characteristics of this earlier model. First, it suggests that as a survival mechanism, we are primed to *selectively* attend either to or away from the source of threat. Attention is sensitive to stimuli that are evolutionarily correlated with threat (e.g. snakes, spiders, angry faces). Second, this selective attention to threat occurs at an *automatic* level, in that it is involuntary and occurs outside of conscious awareness. Third, through *Encapsulation,* once the automatic, selective attention to threat is initiated, it is maintained over time and resistant to conscious influence. Lastly, a functional relationship between ecological events and behaviour is seen to be moderated by a specific *neural circuit*. From an evolutionary perspective, specific brain areas (i.e., subcortical and brainstem) are associated with fear and fear learning. Specifically, this neural circulatory is seen to centre on the amygdala and also involves other brain regions (e.g., hypothalamus and thalamus).

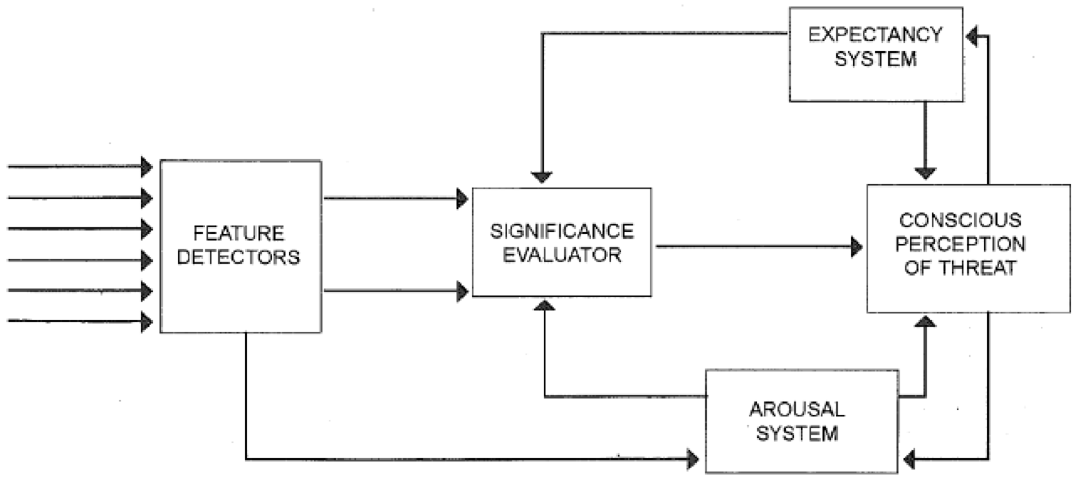

Figure 1.3. Öhman's (1993) information processing model of anxiety. Figure adopted from Öhman (1993), Fear and anxiety as emotional phenomena: Clinical phenomenology, evolutionary perspectives, and information-processing mechanisms. In M. Lewis & J. M. Haviland (Eds) *Handbook of the Emotions (pp. 511-536)*. NY & London: The Guilford Press.

Similarities and Differences between the Models

The models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) share a number of similarities regarding the mechanisms that underpin attentional processes in anxiety. First, all models propose that anxiety and/or high arousal is characterized by an attentional bias favouring threatening stimuli. Second, attentional biases to threat are automatic in that they are involuntary. Third, attentional biases to threat are automatic in that they occur outside of conscious awareness.

Despite these similarities the models differ in several ways. First, the aforementioned models differ on the emphasis for conscious awareness in activating selective attention toward threatening stimuli in anxious individuals. For example, Öhman (1993) places the importance on priming of threat during conscious processes to elicit selective attention at preattentive levels. Mogg and Bradley (1998) and Clark and Beck (2010) do not specify the need for conscious awareness of stimuli in order to activate attentional biases toward threat when stimuli are presented outside of conscious awareness.

Second, the models differ on their emphasis on state and trait anxiety in moderating attentional biases to threat. Clark and Beck (2010) suggest that attentional biases favouring threatening information are most prominent in those with a predisposition to anxiety (trait anxiety), whereas Öhman and Mineka (2001) propose that it is the current levels of anxiety (state anxiety) that are most significant for this process to become activated. Mogg and Bradley (1998) on the other hand propose a hypothesis that stresses the importance of both trait and state anxiety. They propose that with elevated state anxiety, high trait anxious (HTA) individuals will direct their attention toward the source of threat whereas low trait anxious (LTA) individuals will direct their attention away from the source of threat, but only for stimuli evaluated as low in threat value. As for high threat value stimuli, both HTA and LTA individuals are predicted to attend toward the source of threat. However, when state anxiety is low, no difference in threat processing is expected between the HTA and LTA individuals.

Implications for the Treatment of Anxiety

Based on the aforementioned theories on attention and anxiety (Beck & Clark, 2010; Mogg & Bradley, 1998; Öhman & Mineka, 2001) it is suggested that anxiety is characterized by an attentional bias to threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. According to McNally (1995) if attentional biases for threat really are automatic then current treatments utilizing verbal strategies that rely on conscious processing of information to correct for any maladaptive attentional responses would not be effective.

Clark and Beck (2010) address the above assertion by suggesting that verbal protocols are necessary but not sufficient in the intervention of anxiety disorders. Clark and Beck propose that the focus of cognitive therapy for anxiety should be on the elaborative strategic process during the secondary reappraisal stage. According to their model, attentional biases in anxiety are comprised of both automatic and strategic processes, that is, threat meaning is assigned at the automatic stage of processing and is followed by continuous anxious thinking at a conscious level. However, the concern with driving treatment based on this model is the question of how to modify the automatic exaggerated threat appraisal without recourse to anxiolytic medications.

Beck and Clark (1997) propose five ways that consciously moderated strategies (i.e., cognitive based therapies) can be effective in the treatment of anxiety. One way is to apply verbal strategies to deactivate the primal mode by employing more constructive and reflective modes of thinking to challenge the validity of anxious thoughts, in much the same way that a non-anxious individual would at an automatic level (e.g, challenging cognitive distortions). Second, exposure based protocols can be used to activate the threat mode while consciously challenging cognitive distortions rather than engaging in cognitive avoidance. Third, the benefits of verbally moderated protocols will not be affected by the involuntary component of the automaticity hypothesis because according to Beck and Clark, all psychological disorders most likely exhibit involuntary cognitive processing, but the distinction between voluntary and involuntary is poorly defined in that it most likely varies in degree not kind and most cognitive processes involve both automatic and strategic processes. Fourth, there is experimental evidence (e.g., Mathews & MacLeod, 1994) to suggest that conscious processes can override automatic involuntary behaviours and processes. Lastly, cognitive therapy does not aim to suppress involuntary anxious thinking but rather to engage in more constructive thinking while minimizing the threat related cognitive avoidance. In sum, Beck and Clark

(1997) argue that the rationale for cognitive therapy is not to abolish biases in thinking but rather to abolish negative threat related biases and increase an individual's functioning, which may be a result of a construction of positive cognitive biases.

Mogg and Bradley (1998) also proposed a treatment based on their cognitive motivational model of anxiety. They suggest that that cognitive restructuring should be the focus of therapy by targeting the initial threat appraisal to reassess and restructure the negative threat related associations with stimuli. However, this proposed treatment laid out by Mogg and Bradley is puzzling in relation to their model which is based on automatic processes. As can be seen in Figure 1.1, the initial stimulus appraisal occurs in the VES which feeds output to the GES prior to conscious awareness and is impenetrable to conscious influence. Any consciously moderated attempts at cognitive restructuring of initial threat appraisals would be ineffective based on this model. Similar criticisms are attributed to Öhman and Mineka's (2001) model which suggests that the fear module is encapsulated and thus impenetrable to conscious influence. However, it may be that cognitive restructuring at the conscious level might affect subsequent exposures at the pre-conscious level. Nonetheless, cognitive behavioural treatments which utilize verbal protocols, exposure interventions and relaxation strategies have been shown to be effective in the treatment of anxiety disorders and thus are considered the chosen evidence based treatment among many clinicians (Otte, 2011).

In conclusion, the aforementioned theoretical models do not offer any effective basis on which to devise effective treatment strategies that rely on verbally moderated protocols. Given the theoretical predictions and empirical evidence for the automaticity of attentional biases to threat in anxiety, it would appear that treatment strategies would be most efficient if they were able to modify both the conscious and preconscious cognitive processes. Despite this limitation, verbally moderated treatments strategies (e.g., Cognitive Behavioural

Therapy), which rely on conscious awareness of threat appraisals, are the evidence based treatments of choice among psychologists and appear to provide significant reduction in anxious pathologies in a relatively minimal number of sessions. Therefore, it may be the case that the preconscious processes that are believed to be so impenetrable to conscious influence may be altered through consciously moderated strategies after all.

Chapter Summary

In Chapter 1, four influential theoretical perspectives were introduced. These models propose that anxiety is characterized by an attentional bias to threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. Differences among models were also discussed. On the basis of theoretical perspectives treatment implications for anxiety disorder were also discussed. Chapter 2 introduces the empirical literature that formed the foundation of the aforementioned theoretical perspectives.

Chapter 2

Empirical Review of the Automaticity of Attentional Biases to Threat in Anxiety

The present chapter reviews the empirical evidence for the automatic nature of attentional bias to threat in anxiety. This chapter further reviews how these empirical findings have contributed to the development of the theoretical perspectives (i.e., Clark & Beck, 2010; Mogg & Bradley, 1998; Öhman & Mineka, 2001) described in Chapter 1. The central focus of this chapter is to review and critically evaluate empirical literature investigating the following: (1) attentional biases for verbal and pictorial threat in clinical and non-clinical high trait anxious (HTA) and low trait anxious (LTA) samples; (2) automaticity of attentional biases to threat in anxiety, that is, the extent to which these processes occur without volition and without conscious awareness; (3) the role of priming in activating attentional biases to threat without awareness. This chapter will further evaluate methodological limitations and interpretational difficulties arising from these studies and will conclude with a rationale for the present research program.

General Evidence – Attentional Bias to Verbal Threat

According to the empirically driven theories of Mogg and Bradley (1998), Clark and Beck (2010), and Öhman and Mineka (2001), anxiety is characterised by an attentional bias to threat. Attentional bias to threat is conceptualized as the preferential allocation of attention to threat related stimuli compared to non-threat stimuli (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007; Mogg & Bradley, 1998). Cisler and Koster (2010), who reviewed research investigating the mechanisms responsible for attentional biases to threat in anxiety, have proposed that the observable components of attentional bias can be measured by three characteristics: (1) facilitated attention, (2) difficulty in disengagement and (3) attentional avoidance. Facilitated attention is evidenced by faster detection of threat stimuli compared to non-threat stimuli and infers that attention is *drawn* to the threat related stimulus more quickly and easily than other stimuli (i.e., non-threat stimuli) (Cisler, Bacon & Williams, 2009). Difficulty in disengagement implies that it is harder to disengage from threat related stimuli or the location of threat related stimuli compared to non-threat related items, because attention has been *captured* by threat relative to other stimuli. Difficulty in disengagement is also referred to as "attentional interference" (Pineles, Shipherd, Welch & Yovel, 2007, p. 1905).   Attentional avoidance suggests the allocation of attentional resources towards locations *away from* the location of threat related stimuli (Cisler et al., 2009). Research suggests that anxious individuals demonstrate an attentional bias to threat related relative to neutral stimuli and that this attentional bias to threat is less apparent in non- anxious populations (for reviews see Bar-Haim, 2007; Cisler et al., 2009; Cisler & Koster, 2010; Mogg & Bradley, 1998).

Selective allocation of attention to threat related stimuli is a robust phenomenon observed across various anxiety disorders such as post-traumatic stress disorder (PTSD; for review see Buckley, Blanchard, & Neill, 2000), generalized anxiety disorder (GAD; for review see Mogg & Bradley, 2005), obsessive compulsive disorder (OCD; for review see Summerfeldt & Endler, 1998), social phobia (for reviews see Clark & McManus, 2002; Heinrichs & Hofman, 2001; Musa & Lepine, 2000) and panic disorder and phobias (for review see McNally, 1999) and across different experimental paradigms (for reviews see Bar-Haim et. al 2007, Cisler et al., 2009; Cisler & Koster, 2010).

Various experimental paradigms (i.e., visual search task, spatial cueing task, dot probe tasks, flanker task and emotional Stoop task) have been employed to investigate the attentional allocation to verbal threat in individuals with anxiety related disorders and non-anxious samples by presenting participants with threat related and non-threat related verbal stimuli and asking them to perform various tasks capable of assessing attentional allocation.

The rationale for these methodologies was derived from experimental research showing that attentional allocation to threat in anxiety can be determined on the basis of reaction times to visual targets. Across these paradigms, attentional biases to threat are observed when anxious individuals, compared to their non-anxious counterparts, selectively attend to the threat related relative to non-threat related stimuli by means of facilitated attention to threat or difficulty in disengaging from threat. Facilitated attention to threat in anxiety is a central prediction of all theoretical perspectives described in Chapter 1 (Clark & Beck, 2010; Mogg & Bradley, 1998; Öhman & Mineka, 2001) and is attributed to the early, automatic stages of processing, whereas only Clark and Beck (2010) propose that attentional biases to threat can also be attributed to difficulties in disengaging from threat, which is thought to occur in the later, more strategic stages of processing (for review see Cisler & Koster, 2010).

Visual Search Task

Attentional biases for threat related words relative to neutral words have been observed in studies employing the visual search task with clinically anxious samples diagnosed with GAD (Rinck, Becker, Kellermann & Roth, 2003), PTSD (Pineles, Shipherd, Mostoufi, Abramovitz & Yovel, 2009; Pineles, Shipherd, Welch & Yovel, 2007) and other anxious pathologies (for review see Cisler et al, 2009). The rationale for employing the visual search task is that it allows for the investigation of spatial attentional allocation to threat information (Cisler & Koster, 2010). In a prototypical version of the visual search task, participants are presented with a target stimulus (i.e., threat stimulus or non-threat stimulus) that is embedded in a matrix (e.g., 3 rows X 3 columns) of distracting stimuli (i.e., threat or non-threat stimuli). Sometimes the target appears in the matrix of distractors (target present trials) and sometimes it does not (target absent trials). The participants' task is to manually respond to the presence or absence of the target by pressing 'Yes" if target is present among the set of distractors (target present trials) or "No" if the target is absent in the set of distractors (target absent trials). Target present trials are used to assess attentional allocation. This task allows for investigations of facilitated attention toward threat as well as difficulties in disengaging from threat. Specifically, facilitated attention to threat is associated with faster reaction times (RT) to identify a threat target in a matrix of neutral distractors compared to neutral targets in a set of neutral distractors because attention is seen to be "*drawn"* to the threat stimuli. Difficulty in disengaging from threat (threat interference) is associated with longer RT to identify a neutral target in a matrix of threat distractors compared to neutral targets among neutral distractors because attention is seen to be "*captured" by* the threat items (Cisler & Koster, 2010).

Rinck et al. (2003) employed a modified version of the visual search task by presenting participants diagnosed with GAD and non-anxious controls with GAD-related (e.g., anxious), neutral (e.g., apron) and positive words (e.g., dreamy). Participants were instructed to search for a single target word (GAD related, neutral or positive) embedded in an 8 X 3 matrix of distracter words. The distracter words consisted of either other GAD-related, neutral or positive words. The target was either present in the matrix, requiring a response of "YES", or absent, requiring a response of "NO". Only data for target present trials were analysed. Rinck et al. (2003) found that GAD participants, compared to the non-anxious controls, demonstrated an attentional bias for threat distractibility as evidenced by longer reaction times to identify a non-GAD related target among a set of GAD related distractor words compared to non-GAD related distractors.

In line with Rinck et al. (2003), similar results were found by Pineles et al. (2007) who employed the visual search paradigm with a clinical sample of Vietnam veterans diagnosed with PTSD. Participants were divided into a low and high PTSD group based on scores on the PTSD checklist and presented with four categories of word stimuli: threat-relevant words (e.g., helicopter, ambush), semantically-related neutral words (e.g., pencil, eraser) and unpronounceable letter strings (non-words). Pineles et al. found evidence for an attentional bias to threat words in the high but not low PTSD participants. That is, the high PTSD participants took longer to identify non-threat related words that were embedded among threat related words relative to other semantically related non-threat words. In a follow up study, Pineles et al. (2009) found the same pattern of results in their high PTSD sample with an additional specificity effect (increased interference to detect a neutral word when it was embedded among trauma related threat words).

Spatial Cueing Task

When taken together, data from studies employing the visual search task suggest that PTSD may be characterized by an attentional bias for threat distractibility that is most apparent when the threat is in the participant’s domain of concern (PTSD relevant threat). Selective processing of threat words has also been found in socially anxious participants on spatial cueing tasks. In line with the visual search task, the spatial cueing task also allows for the investigation of spatial attentional allocation to threat information. In a prototypical version of the spatial cueing task (Posner, 1980), participants are presented with two rectangles, one to the left and one to the right side of a fixation point on a computer screen and instructed to focus on the fixation point. A cue is then presented in one of the two rectangles and replaced by a target (i.e., asterisk). The cues are either presented in the same rectangle (valid cues) or opposite rectangle (invalid cues) as the target. The validity of the cues is determined by the ratio of targets replacing cued regions. The participants’ task is to respond to the position of the target. Reaction times (RT) for responses are recorded. This task allows for investigations of facilitated attention toward threat and difficulties in disengaging from threat. Attentional bias to threat in anxious individual is noted by faster responses to threat cues on valid trials (threat facilitation) or slowed responses to threat cues on invalid trials (difficulty in disengaging from threat).

Amir, Elias, Klumpp and Przewroski (2003) employed this paradigm with participants diagnosed with social phobia and non-anxious controls. In this study, participants were instructed to focus on a fixation cue displayed between two rectangles positioned on the left and right side of the screen. A threat (e.g., stupid), positive (e.g. confident) or neutral (e.g. tile) word was then presented in one of the rectangles. At the offset of the word an asterisk was presented in one of the rectangles. On valid cue trials, the asterisk was presented in the same rectangle as the cue, and in the opposite rectangle on the invalid cue trials. The participants responded using a left or right button press to indicate the position of the asterisk (target). Amir et al. found evidence for an attentional bias to threat in their social phobic participants compared to non-anxious controls as evidenced by longer reaction times to respond to the invalid cue on threat relative to non-threat word trials.

Dot Probe Task

Evidence for threat processing biases in samples with GAD (e.g., MacLeod, Mathews & Tata, 1986; Taghavi, Neshat-Doost, Moradi, Yule & Dalgleish, 1999) and OCD (e.g., Amir, Najmi & Morrison, 2009; Tata, Leibowitz, Punty, Cameron & Pickering, 1996) were also observed in studies employing dot probe reaction time tasks. In a prototypical version of this task, pairs of words (e.g., threat words and/or neutral words) are presented on a computer screen for a brief time (e.g., 500 msec). One word is displayed on the upper part of the screen while the other is displayed on the lower portion of the screen. At the offset of the word, a probe (e.g., "*") appears in the spot formerly occupied by one of the words. The participants' task is to quickly and accurately indicate whether the probe replaced the top or the bottom word by manually pressing a corresponding button. Alternatively, participants can be asked to classify the type of probe (e.g., square vs. circle) that replaced one of the words. The manual RT to identify the probe is taken as a measure of attentional allocation to the attended rather than unattended part of the screen. Attentional bias to threat is evidenced by faster RT to identify the probe that replaced the threatening word compared to the non-threat word.

MacLeod et al. (1986) presented participants with GAD and non-anxious controls with threat related and non-threat related word pairs. On each trial one word was presented on the upper area of a computer screen while the other was presented on the lower area of the screen. Participants were instructed to read the upper word aloud. On some trials a probe was presented in the area formerly occupied by one of the words. The participants' task was to press a hand held button as quickly and accurately as possible when they detected the probe. The results indicated that GAD participants, compared to their non-anxious counterparts, were faster at identifying the probe when it replaced the threat related words compared to the neutral words, suggesting a facilitated attention to threat. Using the same paradigm, Taghavi et al. (1999) also found that GAD participants, relative to non-anxious controls, were faster at detecting probes that replaced threat related words compared to probes that replaced non-threat related words. Amir et al. (2009) and Tata et al. (1996) found similar results with OCD participants. Similar findings have been reported by others (for reviews see Bar-Haim et al., 2007; Cisler et al., 2009; Cisler & Koster, 2010) and are in line with the aforementioned visual search and spatial cueing studies.

Section Summary

Studies employing the visual search, spatial cueing and dot probe paradigms as a means of assessing attentional allocation for verbal threat in clinically anxious participants have found an attentional bias toward verbal threat in clinically anxious individuals compared to non-anxious controls. When taken together the aforementioned findings provide support for the first prediction made by the models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) described in Chapter 1. That is, they provide evidence for the prediction that anxiety is characterized by an attentional bias to threat.

However, despite the effectiveness of these tasks to provide measures of attentional allocation (for reviews see Bar-Haim et al., 2007; Cisler et al., 2009; Cisler & Koster, 2010), these experimental paradigms do not support the automatic nature of any disruptions in task performance because individuals may choose to allocate attentional resources toward threat stimuli before they are required to respond to the location or to classify the probe, or to detect a target among distractors. Despite extremely fast exposure duration, in the absence of attentional competition it is still possible that subjects might choose to direct their attentional resources toward one location over another. This methodological limitation is problematic for investigating the second prediction made by the theoretical models described in Chapter 1. To account for this limitation, others (for review see Bar-Haim et al., 2007; Cisler & Koster, 2010; Cisler et al., 2009; Mogg & Bradley, 1998; Williams, Mathews & MacLeod, 1996) have employed interference paradigms (e.g., emotional Stroop task). The rationale for employing interference paradigms was derived from experimental research showing that attentional bias to threat without volition can be determined on the basis of reaction times to visual targets when there is a competition for attention between tasks.

Automaticity - Attentional Bias to Verbal Threat without Volition

The evidence for the automaticity hypothesis of selective attention to threat in anxiety has been largely obtained from studies that have employed interference paradigms (e.g., emotional Stroop task, flanker task) with anxious and non-anxious participants. In these paradigms participants are instructed to ignore distracting information (e.g., threat stimuli) while performing a central task. On these tasks selective attention for emotional stimuli is evidenced by interference in task performance. The following section presents evidence for the involuntary selective allocation of attention to threat words in clinical and non-clinical HTA and LTA participants.

Emotional Stroop Colour Naming Task: Clinical Studies

The emotional Stroop colour naming task, a modified version of the original Stroop colour naming task (Stroop, 1935), has been one of the more popular interference paradigms for the purpose of assessing automatic attentional biases to threat in anxiety (see reviews by Bar-Haim et al., 2007; Cisler et al., 2009; Cisler & Koster, 2010; Mogg & Bradley, 1998; Williams, Mathews & MacLeod, 1996). This task is capable of assessing the involuntary aspect of the automaticity hypothesis because the 'to-be-attended-to' stimuli (i.e., colour) and the 'to-be-ignored' stimuli (i.e., words) are presented as integrated features of the same stimulus, thus promoting a competition for attention between two features. Therefore, any disruption in task performance is presumed to occur without volition.

In this paradigm, participants are instructed to respond to the colour (red, green, blue, yellow) of a word while ignoring the semantic content (threat related vs. neutral) of that word. Longer reaction times to name a colour of a threat related word (e.g., hate, kill) relative to a non-threat related word (e.g., bath, pillow) are taken as an index of threat interference, whereas threat facilitation is observed by faster reaction times to name the colour of a threat related word relative to a non-threat related word. It is presumed that interference in colour naming for some word types occurs because the semantic nature of these items captures attentional resources. Therefore, if anxiety is characterised by an attentional bias to threat, then on the emotional Stroop colour naming task, anxious participants are expected to demonstrate interference for colour naming threat related relative to non-threat related words.

Bryant and Harvey (1995) and McNally, Kaspi, Riemann and Zeitlin (1990) investigated the relationship between attention and anxiety by employing one such task with clinically anxious participants. In these studies, clinically anxious participants with PTSD and non-clinical controls were presented with threat related (e.g., accident, crash) and non-threat related (e.g., desk, chair) words with the task being to name the colour (i.e., red, green, blue or yellow) of the words as quickly and accurately as possible while ignoring the semantic content of the words. Bryant and Harvey (1995) and McNally et al. (1990) found an interference in colour naming of threat words in the PTSD group compared to their non-anxious counterparts. That is, participants with PTSD displayed longer RT to colour name threat related relative to control words compared to their non-anxious counterparts, a stronger interference effect.

These findings are taken as an index of the extent to which verbal threat has captured attentional resources. Similar patterns of colour naming have been found across different anxious pathologies such as panic disorder (e.g. Teachman, Smith-Janik & Saporito, 2007), OCD (e.g. Tata, Leibowitz, Prunty, Cameron & Pickering, 1996), GAD (e.g., Mathews & MacLeod, 1985; Mogg & Bradley, 2005), spider phobia (e.g. Watts, McKenna, Sharrock & Treazise, 1986) and social phobia (e.g. Hope, Rapee, Heimberg, & Dombeck, 1990; Mattia, Heinberg & Hope, 1993) (see Bar-Haim et al., 2007; Cisler et al., 2009; Cisler & Koster, 2010; Mogg & Bradley, 1998, for reviews).

Flanker Task: Clinical Studies.

The emotional Stroop colour naming task has been further modified into the flanker task whereby the ‘to–be-attended- to’ (e.g., colour) and ‘to-be-ignored’ (e.g., word) information is spatially separated. In the flanker task, participants are instructed to respond to a target (to- be-attended- to) stimulus (e.g., identify a word colour or identify a number as odd/even) while ignoring a flanker stimulus (e.g., threat or non-threat word). Reaction times to respond to the target stimuli are recorded. Longer reaction times to identify the targets that are presented with threat related flankers compared to neutral flankers are taken as in index of threat interference.

In a prototypical version of the flanker task (Eriksen & Eriksen, 1974), participants are presented with a letter (e.g., H or S) that is flanked by 4 congruent (HHHHH or SSSSS) or 4 incongruent (SSHSSS or HHSHH) letters (flankers). The participant's task is to manually identify the central letter (i.e., left button press for "H" vs. right button press for "S") as quickly and accurately as possible. The RT for correct responses on the incongruent trials minus the RT for correct responses on the congruent trials is taken as an index of attentional allocation to the target stimulus. Positive scores reflect interference whereas negative scores indicate facilitation. This task has been modified for use with emotional stimuli.

Mathews, May, Mogg and Eysenck (1990) employed a modified version of the original flanker task with individuals diagnosed with GAD, recovered GAD and non-anxious participants as a means of assessing attentional allocation to threat. All participants were presented with one of two target words (e.g., left, right) along with two distracting words (distractor present condition) or in the absence of these distractors (distractor absent condition). Distractors consisted of neutral (e.g., horizon), positive (e.g., generous), physical threat (e.g., crippled) or social threat (e.g., ashamed) words. The target was either presented in a location indicated by an asterisk (known location) or following three vertically placed asterisks of which one would be replaced by the target word (unknown location). Participants held a response button in their left and right hand and were instructed to press the corresponding button to the target word (left button for the target word left and right button for the target word right) while ignoring the distracting word. Mathews et al. (1990) found that compared to non-anxious controls, GAD and recovered GAD participants were slower to identify the target when it was presented with threat related distractors (physical and social) relative to non-threat related distractors. These findings suggest an attentional bias to threat as a function of GAD.

Based on these two paradigms, it is probable that the interference to colour name certain words (i.e., threat words), or identify a target flanked by threat words, is a result of captured attention or a difficulty in disengaging from the semantic content of these words. Furthermore, because participants are instructed to ignore the semantic content of the stimuli, the RT to identify the target stimulus can be taken as a measure of the extent to which attention is captured by or drawn to the meaning of the words counter to intention.

In sum, research employing interference paradigms to assess the involuntary nature of attentional biases to threat with samples of clinically anxious participants (e.g., Bryant & Harvey, 1995; Mathews et al., 1990; McNally, Kaspin et al., 1990; for reviews see Bar-Haim et al., 2007; Cisler et al., 2009; Cisler & Koster, 2010) have found that despite instructions to ignore the semantic content of the words, clinically anxious participants relative to their non-anxious counterparts demonstrated an interference to colour name threat related relative to non-threat related words (emotional Stroop task) or to identify a target flanked by threat related verbal stimuli. Findings are taken as evidence of the involuntary nature of attentional bias to threat in anxiety and provide support for all theoretical perspectives described in Chapter 1.

A limitation of the research studies presented to this point is that they investigated attentional allocation to threat words in clinically anxious participants and non-anxious controls. However, because clinical anxiety is typically characterized by elevated levels of both state and trait anxiety (e.g., Spielberger et al., 1983) the relative contribution of these variables in attentional biases to threat is difficult to determine. Therefore, in order to understand the separate influences of state and trait anxiety on selective attention to threat, some researchers have turned to using non-clinically anxious samples as participants. The rationale for including non-clinical samples is that they vary along trait anxiety levels, and state anxiety can be manipulated through various experimental procedures.

The theoretical models described in Chapter 1 made several predictions regarding the relative influence of state and trait anxiety in moderating selective processing of threat. Clark and Beck (2010) place emphasis on the predisposition to anxiety (trait anxiety), whereas Öhman and Mineka, (2001) propose that it is the current level of anxiety (state anxiety) that is most significant in moderating attentional biases to threat. Mogg and Bradley (1998) stress the importance of both trait and state anxiety for this process to occur. They propose that with elevated state anxiety, HTA individuals will direct their attention toward the source of threat whereas LTA individuals will direct their attention away from the source of threat, but only for stimuli evaluated as low in threat value. As for high threat value stimuli, both HTA and LTA individuals are expected to attend toward the source of threat. However, when state anxiety is low, no difference in threat processing is expected between the HTA and LTA individuals.

Emotional Stroop Colour Naming Task: Non-Clinical Studies

To investigate the separated effects of state and trait anxiety on the involuntary nature of selective processing for verbal threat, Russo, Whittuck, Roberson, Dutton, Georgiou, and Fox (2006) and Fox (1993) employed interference paradigms with a non-clinical sample of HTA and LTA participants. Russo et al. (2006) applied a card version of the modified emotional Stroop colour naming task with HTA and LTA participants. Allocation to trait anxiety group was determined on the basis of questionnaire scores (STAI; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983). Participants were presented with threat related (e.g., failure, murder) and non-threat related (e.g., cupboard, lobster) words printed in various colours (red, blue, black, pink and green). The instructions were to name the colour of each word as quickly and accurately as possible while ignoring the semantic content of the items. Russo and colleagues found that the HTA relative to LTA participants demonstrated an attentional bias to threat related words relative to the neutral words as evidenced by longer RT to colour name threat relative to neutral words. Similar results were found on the emotional Stroop and flanker tasks by Fox (1993) and others (for review see Bar-Haim et al., 2007).

Fox (1993) conducted two experiments using the traditional emotional Stroop colour naming task and a modified 'separated' version of this task. On the emotional Stroop task, Fox presented HTA and LTA participants with colour (red, blue, green, brown, and yellow), neutral and threat related words in various colours (red, blue, and green, brown, yellow). Participants were asked to name the colour of each word as quickly and accurately as possible, while ignoring the semantic content of the word. On the flanker task, Fox presented colour patches flanked by the same word above and below the patch (colour, neutral or threat word). Participants were instructed to name the colour of the patch as quickly and accurately as possible while ignoring the semantic content of the word. In both experiments, Fox found that the HTA participants took longer to colour name threat related relative to neutral words and colour patches that were presented with threat related relative to neutral or colour (flanker task) words, whereas no difference in colour naming for the LTA group was found. Eysenck and Byrne (1992) found similar results on the flanker task and others (for review see Bar-Haim et al., 2007; Cister & Koster, 2010; Mogg & Bradley, 1998) on the emotional Stroop task.

The finding of Russo et al. (2006), Fox (1993) and others (e.g., Eysenck & Byrne, 1992; for reviews see Bar-Haim et al, 2007; Cisler & Koster, 2010; Mogg & Bradley, 1998) suggest that despite instructions to ignore the semantic content of the words, HTA relative to LTA participants demonstrated an interference to colour name threat related relative to non-threat related words or identify colour patches flanked by threat words. In line with the theoretical models described in Chapter 1, these finding are taken as evidence for the attentional bias toward threat in HTA. In addition, because participants were instructed to respond to a target while ignoring distracting information (semantic content), these finding provide support for the involuntary nature of selective attention of threat in anxiety. However, a limitation of the aforementioned non-clinical studies is the absence of state anxiety manipulation which is central to the theories of Mogg and Bradley (1998) and Öhman and Mineka (2001). Therefore, it is unclear whether increased state anxiety levels may have produced different attentional patterns in these studies (see Mogg & Bradley, 1998, for a review).

Section Summary

Longer colour naming reaction times on the emotional Stroop and flanker tasks are interpreted as attentional allocation toward the semantic content of the stimuli and therefore any colour naming interference is presumed to be involuntary because participants are explicitly instructed to ignore the semantic content of the words. According to Mogg and Bradley (1998) these findings may also be attributed the tasks' difficulty in distinguishing between encoding bias and response bias and/or the possibility that the presence of threatening words may momentarily arouse HTA participants, causing interference in colour naming threat related words. Despite these alternative interpretations, it appears that the emotional Stroop and flanker tasks are methodologically appropriate for assessing the involuntary nature of selective attention to threat in anxiety, relative to alternative tasks that do not require competition for attentional resources.

In sum, the findings of the above mentioned interference paradigms suggest that anxiety is characterized by an attentional bias to threat and that this bias is automatic in that it occurs without volition, thus providing support for the first prediction and the first part of the automaticity hypothesis proposed by the theoretical perspectives described in Chapter 1. However, a limitation of the aforementioned studies is that they do not provide information for the second component of the automaticity hypothesis which states that attentional bias for threat occurs outside of conscious awareness, because participants were consciously aware of the semantic nature of the stimuli. In an attempt to investigate the role of awareness on selective processing of threat some researchers have attempted to limit conscious awareness of stimuli on a dichotic listening task, limiting cognitive processing abilities, or by masking stimuli on the dot probe and emotional Stroop tasks to prevent conscious awareness of the stimuli.

Automaticity - Attentional Bias to Verbal Threat without Awareness

Dichotic Listening Task: Clinical Studies

In attempting to investigate the role of awareness in the selective processing of threat words in anxiety, a number of earlier studies employed the dichotic listening task, a type of resource limited paradigm that requires participants to simultaneously process multiple inputs. Each individual input is capable of reaching consciousness, but the presentation of simultaneous multiple stimuli limits cognitive resources (McNally, 1995). In a prototypical version of this task, participants are presented with two verbal auditory stimuli simultaneously (one to each ear). Participants are instructed to attend to one of the passages by repeating it aloud (shadow) while being presented with input to the other channel. A further task demand is to either recall a number of target words that are presented to the unattended channel or to perform a secondary RT task requiring manual responses. The number of words recalled on the unattended channel or the RT to the secondary task are taken as an index of the degree to which participants process information presented outside of awareness.

Burgess, Jones, Robertson, Radcliffe and Emerson (1981) employed this methodology with a sample of clinically phobic and non-phobic controls. All clinical participants consisted of current or recovered social phobics, whereas sub-clinical agoraphobic, sub-clinical social phobic and non-phobic controls made up three groups of non-clinical samples. Allocation to a group was based on responses to critical items on the Fear Survey Schedule (Wolpe & Lang, 1964). All participants were presented with two prose passages (one neutral, one phobic relevant) simultaneously (one to each channel). Neutral passages included randomly embedded neutral target words (e.g., pick) and the phobia relevant passages included randomly embedded phobia related target words (e.g., failure). Participants were randomly presented with 10 target words in one channel and required to shadow a passage being presented in the opposite channel. The task requirements were to shadow the passage corresponding to their preferred hand while disregarding the second passage and to indicate whether the target word (phobia relevant or neutral) was detected in either channel. Shadowing errors were eliminated from analysis to control for the possibility of a potential switch in attention to the unattended channel message. Burgess and colleagues found that clinically anxious participants recalled more phobic target words in the phobia relevant passage on the unattended channel compared to their sub-clinical phobic and non-anxious counterparts. These findings suggested that compared to their non-anxious counterparts, clinically anxious participants process threat stimuli without conscious awareness. Similar findings were observed with OCD participants (e.g., Foa & McNally, 1986) and those with GAD (Mathews & MacLeod, 1986).

It should be noted that the data from dichotic listening studies should be interpreted with caution because the task has been criticized for being methodologically flawed and an unreliable measure for assessing preattentive processing of threat (Holender, 1986). Holender suggested that awareness of the critical items may have been a result of a momentary attentional shift from the attended to the unattended channel while participants were still accurately able to shadow the prose. It is therefore possible that participants might have been aware of the critical items being presented to the unattended channel, and as such, the notion of subconscious threat processing is questionable.

Given the methodological limitation with this task in assessing for attentional allocation outside of conscious awareness, others have employed visual backward masking procedures for this purpose. This procedure consisted of briefly (e.g., 15 msec) presenting participants with words which were replaced by a random string of letters. In addition, awareness checks, such as forced choice discrimination tasks (e.g., word/non word or word present/ word absent), were employed to ensure that participants remained unaware of masked items (e.g., Edwards, Burt & Lipp, 2006; 2010a; 2010b). Research has shown that despite being unaware of the item content, individuals selectively attended to threat related items (e.g., Edwards et al., 2006).

Dot Probe Task: Clinical Studies

Masked versions of the dot-probe task have been employed to account for the limitations of dichotic listening tasks with clinical (e.g., Mogg, Bradley & Williams, 1995) and non-clinical samples (e.g. Hunt, Keogh & French, 2006; Mogg, Bradley & Hallowell, 1994). For example, Mogg et al. (1995) presented GAD participants with pairs of neutral/negative and neutral/threat related words. One word pair was presented in the upper and one in the lower area of a computer screen. On the unmasked trials the word pairs remained on the screen for 1000 msec followed by a presentation of a probe in the area formerly occupied by one of the words. On the masked trials the word pairs were displayed for 14 msec and replaced by a 14 msec pattern mask. At the offset of the mask, a probe appeared in the area formerly occupied by one of the masks. Participants were instructed to indicate the location of the probe as quickly and accurately as possible. RTs for probe detections were recorded. To ensure that participants did not become aware of masked stimuli throughout the experiment, an awareness check was carried out by way of a forced choice word absent/present discrimination task. RTs for correct responses were analysed and the data indicated that GAD participants relative to non-anxious controls showed greater vigilance for negative relative to neutral words in both the masked and unmasked conditions. There were no differential processing effects for threat words. These findings suggest that clinical anxiety is characterized by an attentional bias for negative information and that this bias occurs outside of conscious awareness.

Dot Probe Task: Non-Clinical Studies

Others (e.g., Hunt et al. 2006; Mogg et al., 1994) have employed masked versions of the dot probe task with non-clinical samples of HTA and LTA participants. For example, Hunt et al (2006) presented low, moderate and high anxious participants with word pairs consisting of neutral words (e.g., lounge) matched with anxiety threat (e.g., afraid), social threat (e.g. alone), positive (e.g., admire) or other neutral words. Half of the trials consisted of masked word pairs, whereas the other half consisted of unmasked word pairs. On the unmasked condition participants were presented with a word pair for 500 msec; at the offset a probe (i.e., "*") replaced one of the words. On the masked exposure condition the word pair remained on the screen for 14 msec and was replaced by a mask consisting of a random string of letters (e.g., trjnglsa) for 486 msec. At the offset of the mask, a probe was presented in the area formerly occupied by one of the words. The probe remained on the screen until participants responded to its location on the screen. The participants were instructed to read each word that appeared on the screen and to manually indicate by pressing the “T” (top) button if the probe replaced the top word and “B” (bottom) if the probe replaced the bottom word. Awareness checks were conducted to ensure that participants did not become aware of masked stimuli throughout the experiment. A threat processing index was calculated by subtracting the mean RT from probes in the same position as the threat word from mean RT when the probe in the opposite position of the threat word. Thus, a positive processing index reflected selective attention to the emotional word (vigilance) whereas a negative index reflected selective attention away from the emotional word (avoidance).

Hunt and colleagues (2006) found that despite being unaware of the stimuli in the masked conditions the high anxiety group demonstrated attentional vigilance to threat words in both masked and unmasked exposure conditions relative to the non-threat items. They further found that on masked trials the high anxiety group demonstrated an avoidance effect for positive words but vigilance when these words were unmasked. In line with all theoretical perspectives described in Chapter 1, these findings provide support for the prediction that anxiety is characterized by an attentional bias to threat and that this bias occurs outside of conscious awareness.

Section Summary

In line with the predictions of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) the aforementioned empirical data provide support for the predictions that anxiety is characterized by an attentional bias to threat. On the basis of interference paradigms, the data further support the first component of the automaticity hypothesis suggesting that selective attention to threat in anxiety occurs counter to intention.

While the dichotic listening and dot probe data provide support for the second component of the automaticity hypothesis, which suggests that selective attention to threat in anxiety occurs outside of conscious awareness. It should be noted that the data from dichotic listening studies should be interpreted with caution because the task has been criticized for being methodologically flawed and an unreliable measure for assessing preattentive processing of threat (Holender, 1986). The following section will discuss evidence for attentional biases to verbal threat with respect to both components of the automaticity hypothesis by employing a masked version of the emotional Stroop colour naming task.

Automaticity - Attentional Bias to Verbal Threat without Awareness and Volition

In an attempt to investigate both the involuntary and outside of awareness aspects of attentional biases to threat in anxiety, masked versions of the emotional Stroop colour naming task have been employed with clinical (e.g., Bradley, Mogg, Millar & White, 1995; Harvey, Bryant & Rapee, 1996; Mogg, Bradley, Williams & Mathews, 1993) and non-clinical HTA and LTA participants (e.g. Edwards, Burt & Lipp, 2006, 2010a, 2010b; Macleod & Rutherford, 1992; Rutherford, MacLeod & Campbell, 2004).

Clinical Studies

Mogg et al. (1993) employed a masked version of the emotional Stroop colour naming task with clinically depressed, clinically anxious and normal controls. Participants were presented with masked and unmasked negative (e.g., anxiety relevant: embarrass; depression relevant: misery), positive (e.g. adorable) and neutral (e.g. carpet, geography) words on colour patches of red, green, blue and pink. Participants were instructed to name the colour of the patch while ignoring the semantic content of the word as quickly and accurately as possible. In the unmasked exposure condition, the words remained on the screen until the participant’s vocal response to the colour was recorded. On the masked trials the word remained on the screen for 14 msec and replaced by a mask consisting of a random string of upper case letters (e.g., WNJOKL). Mogg et al. (1993) found that relative to depressed and normal controls, anxious participants demonstrated slower colour naming for negative words in both exposure conditions. Similar findings were reported by Harvey et al. (1996) who also administered the colour naming task with masked (14 msec) and unmasked threat and non-threat related words to individuals diagnosed with PTSD who were motor vehicle accident (MVA) survivors, MVA survivors without PTSD and non-accident controls. Awareness checks were conducted between each block of trials to ensure that participants remained unaware of stimuli on the masked trials and consisted of a word / non-word lexical decision task. The findings revealed that on the masked and unmasked trials the PTSD group showed significantly more colour naming interference for threat words than the other groups. Bradley et al (1995) also found that GAD participants compared to non-anxious controls demonstrated slower colour naming for negative words compared to neutral words in both masked and unmasked exposure conditions. Taken together, these findings suggest that anxiety is characterized by an involuntary preattentive processing of threat.

In sum, the evidence suggests that processing of threat in clinical anxiety might operate counter to intention and prior to conscious awareness of stimuli. These finding provide support for all theoretical models described in Chapter 1. However, the relative contribution of state and trait anxiety is unknown because these studies examined clinically anxious participants. To investigate the separate effects of state and trait anxiety on attentional allocation to threat without awareness and volition, others (e.g. Edwards et al, 2006; 2010a; Macleod & Rutherford, 1992; Rutherford et al, 2004) have employed masked versions of the emotional Stroop task with non-clinical HTA and LTA participants performing under low and high stress conditions.

Non-Clinical Studies

MacLeod and Rutherford (1992) investigated the attentional patterns of HTA and LTA participants under high and low stress conditions. Stress conditions were manipulated by first testing participants one week prior to exams (high stress condition) followed by testing participants early in the semester, six weeks following the exam period (low stress condition). Participants were presented with an intermixed sequence of unmasked and masked general threat words (e.g., die, danger), non-threat words (e.g., table, chair), exam relevant threat words (e.g., fail, dumb) and exam relevant non-threat words (e.g., intelligent, knowledgeable) in various colours (i.e., red, green blue or yellow). The instructions were to indicate the colour of the words as quickly as possible while ignoring the semantic content of the words. On the unmasked trials, the word remained on the screen until the participant's response to the colour was recorded by the software. On the masked trials, the word remained on the screen for 20 msec and replaced by a pattern mask of the same colour which remained on the screen until the participant's response to the colour was recorded by the software.

The masked data indicated that in the high stress condition, despite instructions to ignore the semantic content of the word, HTA participants took longer to colour name masked threat words (exam threat and general threat) compared to the non-threat words, whereas the LTA participants demonstrated a non-significant facilitation to colour name masked threat words in the high stress condition. On the unmasked trials, there was no significant difference in threat processing between the HTA and LTA participants. There was however a non-significant trend in both groups for general threat interference and a facilitated attention for exam threat. Although these data suggest that HTA individuals, when performing under elevated stress, process masked stimuli differently in terms of valence, ordering of state anxiety manipulation may have influenced the data because all participants performed under high stress conditions first followed by the low stress conditions. Therefore, it is not clear whether a similar pattern of responding would be noted if the reverse order of state anxiety manipulation was implemented (see Rutherford MacLeod and Campbell, 2004).

To investigate this possibility, Rutherford et al. (2004) tested participants using the emotional Stroop task but included a reverse stress condition order to that employed by MacLeod and Rutherford (1992). That is, they tested participants under the low stress condition first (early in the semester) followed by the high stress condition (close proximity to semester exams). Rutherford and colleagues presented HTA and LTA participants with positive (e.g., confident), neutral (e.g., desk), and threat related (e.g., violence) words in various colour lettering (red, green, blue or yellow). On half of the trials the words were presented unmasked and on the other half they were replaced by a mask of the same colour. The participants' task was to name the colour of the word as quickly as possible while ignoring the semantic content. Rutherford et al. found that on both masked and unmasked exposure conditions, in the high stress relative to the low stress condition, HTA participants demonstrated interference for threat words compared to the facilitated colour naming for threat observed in the LTA participants. Taken together the findings of Macleod and Rutherford (1992) and Rutherford et al. (2004) suggest that HTA participants demonstrate similar processing of masked threat material to clinically anxious individuals (e.g. Bradley et al., 1995; Harvey et al., 1996; Mogg et al., 1993).

Edwards et al. (2006) also employed the emotional Stroop task with a non-clinical sample of HTA and LTA participants. State anxiety was manipulated through the threat of an electric shock. Participants were presented with masked and unmasked electric threat related (e.g., burn, cable) and general threat words (e.g., abuse, cancer) matched for average length and frequency to non-threat related control words (e.g., fence, sugars). The task was to name the colour (red, green, blue or yellow) of the words as quickly and accurately as possible while ignoring the semantic content of those words. Participants were randomly assigned to a shock threat or a shock safe condition based on their arrival to the laboratory. A threshold exposure setting was employed to determine the individual stimulus onset asynchrony (SOA) for use on the masked trials between the word and the mask. On the unmasked exposure trials, the word remained on the screen until the participant's response to the colour was recorded by the software. On the masked trials the word remained on the screen for the SOA determined during the threshold exposure setting, and was replaced by a pattern mask of the same colour. The mask remained on the screen until the participant's response to the colour was recorded by the software. Awareness checks were employed to ensure that participants remained unaware of stimuli on the masked trials. The result of this study indicated that, on the unmasked trials, the HTA group showed significant interference in colour naming threat words relative to the non-threat words but only while performing under the threat of shock. No difference in processing unmasked stimulus content was noted for the LTA group. On the masked trials, despite being consciously unaware of stimulus content, HTA participants showed a facilitated colour naming for threat words relative to control words but only when performing under the threat of shock. No difference in processing masked stimulus content was noted for the LTA group.

In a follow up study, Edwards, Burt and Lipp (2010a) employed a similar procedure to that employed by Edwards et al. (2006) but with two distinctions: (1) neutral words were replaced with positive words (e.g., wins, jokes) and; (2) shock condition was blocked so that half the participants received the shock condition in the first two blocks followed by two blocks of no shock, whereas the other half received the opposite order (no shock followed by shock). The results indicated that the blocking on the order of the state anxiety manipulation influenced masked and unmasked threat bias effects. Averaged over exposure mode, HTA relative to LTA participants demonstrated interference for threat, but this was limited to those who performed under the threat of shock in the later stages of the experiment. On the unmasked trials, HTA relative to LTA in the shock threat condition demonstrated interference for threat irrespective of shock threat order. The masked stimuli were processed in similar fashion by both HTA and LTA participants irrespective of shock condition and order. Averaged over trait anxiety, shock condition and exposure mode, participants overall demonstrated interference for threat in the early stages relative to the facilitation for threat observed in the later stages of the experiment. In sum, the results indicated that the direction of attention for masked and unmasked threat information changed over the course of testing, in that irrespective of exposure mode, threat interference was noted in the early stages of the experiment compared to the facilitation for threat in the later stages of the experiment.

In summary, the data for the HTA participants on unmasked trials appears to be consistent across a number of studies (Edwards et al. 2006, 2010a; Rutherford et al., 2004) that reported interference for colour naming threat words in the HTA groups when performing under high stress conditions. These processing patterns are similar to those reported for clinically anxious participants (e.g., Bradley et al. 1995; Bryant & Harvey, 1995; Mathews et al. 1990; McNally et al. 1990; Mogg et al., 1993). On masked exposure trials, although similar patterns of interference for colour naming threat words in the HTA groups in the high stress conditions were noted by MacLeod and Rutherford (1992) and Rutherford et al. (2004), Edwards et al. (2006) found a facilitated colour naming for masked threat words when performing under the threat of shock. Given the similarities of task demands (i.e., colour naming), stimuli (i.e., words) and participants (i.e., student samples) between the experiments, the inconsistent findings appear to have been influenced by the differential state anxiety manipulations.

Despite the considerable body of data demonstrating selective attention for masked threat words in anxiety, the aforementioned studies that reported masked threat effects have presented masked and unmasked stimuli in an intermixed sequence. According to the theoretical perspective of Öhman and Mineka (2001), access to consciously perceived threat can prime the mechanisms responsible for processing subliminal threat. Therefore, it is possible that when masked and unmasked stimuli are presented intermixed, conscious awareness of threat on unmasked trials may have primed threat detection on masked trials.

Fox (1996) questioned the extent to which these processes operate outside of conscious awareness and suggested that conscious awareness of threat may affect responses on masked trials. Fox employed three experiments using the Flanker task whereby participants were presented with a digit in the centre of a computer screen with the task being to identify the digit as odd or even as quickly and accurately as possible. Along with the digit, a pair of distractors, threat related or neutral words (derived from Fox, 1994), were presented above and below the digit. On half of the trials word pairs were presented unmasked, whereas on the other half of the trials the words were presented with a backward pattern mask. Fox hypothesised that the RT to identify the digit as odd or even may be influenced by the valence of the distracting word stimuli. That is, longer RT to detect the status of the digit when embedded among threat related distractors would reflect selective attention to threat.

Fox (1996), in Experiment 1, presented HTA and LTA participants with an intermixed sequence of masked and unmasked threat related and neutral words. The results indicated that on masked trials, HTA participants took longer to identify the status of the digit on threat word trials relative to neutral word trials. These data are consistent with the interference to colour name masked threat related relative to masked neural words in non-clinically anxious participants on the emotional Stroop colour naming task. (e.g., Edward et al., 2010a; MacLeod & Rutherford, 1992; Rutherford et al., 2004). To account for the possibility of priming for threat on masked trials, Fox, in Experiment 2, presented participants with a block of masked trials first followed by a block of unmasked trials. The findings revealed a non-significant trend for longer RTs to classify a digit on masked threat word trials in the HTA participants. In Experiment 3, Fox presented half the participants with masked trials first followed by a block of unmasked trials, whereas the other half of participants received the opposite order. Fox found that on the masked trials the data did not produce differential digit classification latencies between the masked threat and masked neutral words when participants were presented with a block of masked trials first followed by a block of unmasked trials. However, when unmasked trials were presented first, HTA participants took significantly longer to classify the digit on the masked threat trials compared to the masked neutral trials. The results were in line with the prediction made by Öhman and Mineka (2001). That is, a masked threat bias was only observed on trials when participants were presented with intermixed masked and unmasked trials (Experiment 1), or when the unmasked trials were presented before the masked trials (Experiment 3).

In line with the predictions of Öhman (1993), Fox (1996) suggested that some conscious awareness of threat may be needed to prime selective attention for threat words that are presented outside of conscious awareness. However, a number of limitations of Fox's work were noted. First, in Experiments 1 and 2, Fox included an experimental procedure to elevate state anxiety; this state anxiety manipulation was not mentioned for Experiment 3. Elevated state anxiety manipulation has been noted in non-clinical samples for producing masked threat effects (e.g., see Edwards et al., 2006; MacLeod & Rutherford, 1992; Rutherford et al., 2004); therefore, the absence of masked threat effects in the masked first exposure condition in Fox's third experiment might be attributed to the absence of state anxiety manipulation. Second, the type of stressor employed in Fox's first and second experiments (past stressor, Experiment 1, vs. future stressor, Experiment 2) may account for the lack of unmasked threat effects for the HTA group.   When considering the elevated 'current' state anxiety reported by clinically anxious individuals, it is possible that state anxiety manipulations reflecting a past and future orientated stressor were not sensitive enough to produce threat processing biases on unmasked trials. Others (e.g., Edwards et al. 2006) have reported threat processing biases on unmasked trials on the emotional Stroop task when the manipulation of state anxiety reflected a current stressor (i.e., threat of an electric shock). Therefore, the differential threat processing for non-clinical participants on the unmasked trials between Fox (1996) and Macleod and Rutherford (1992) as compared to Edwards et al. (2006) may be attributed to the differences in state anxiety manipulation.

Edwards, Burt and Lipp (2010b) accounted for a number of limitations discussed in relation to the aforementioned work. First, Edwards et al. (2010b) employed a state anxiety manipulation reflecting a current stressor (i.e., threat of electric shock) which was administered to all participants. Participants received two blocks of shock threat and two blocks of shock safe trials over four blocks. Shock distribution was administered so that half the participants received shock threat (Block 1), shock safe (Block 2), shock threat (Block 3), shock safe (Block 4), whereas the other half received the opposite sequence (shock safe, shock threat, shock safe, shock threat). Second, in an attempt to investigate whether conscious awareness of threat is needed to produce masked threat biases in a non-clinical sample of HTA and LTA participants, Edwards et al. (2010b) employed the emotional Stroop task by blocking on presentation order; that is, they presented half their participants with blocks of masked trials first followed by blocks of unmasked trials, whereas the other half received the opposite sequence, unmasked blocks first followed by masked trials as a between subject variable. Trait anxiety groups were determined on the basis of questionnaires in accordance with previous work (Edwards et al., 2006; MacLeod & Rutherford, 1992). Individual threshold exposure settings were carried out prior to the experimental trials by implementing a word/non-word lexical decision task. Awareness of word stimuli was manipulated by a backward masking procedure. The SOA between the word and the mask was determined during the initial lexical decision task. Half of the words were presented within conscious awareness (unmasked) and half were presented outside of conscious awareness (masked). All participants were presented with half neutral and half threat related words, masked and unmasked in various colours (red, green, blue or yellow). The instructions were to name the colour of the stimulus as quickly and accurately as possible while ignoring the semantic content of the word. Awareness check trials were conducted to ensure that participants remained unaware of stimuli on masked trials.

The results revealed no difference in threat processing between the HTA and LTA participants when masked trials were presented first. However, when unmasked trials were presented first, for both masked and unmasked exposure conditions, the HTA relative to the LTA participants demonstrated an attentional bias to threat. There were no differential patterns of responding based on state anxiety manipulation. When unmasked trials were presented first, the findings of this study provide support for theories of Clark and Beck (2010), Mogg and Bradley (1998) and Öhman and Mineka (2001), which suggest that an attentional bias to threat is likely to be evidenced in the HTA relative to the LTA and that this bias occurs without volition and outside of conscious awareness. However, because an attentional bias to masked threat was only detected when unmasked trials were presented first, these data give further support for Öhman's (1993) priming hypothesis which states that conscious access to threat is needed to prime the mechanisms responsible for detecting subliminal threat.

Summary – Verbal Stimuli

In line with theoretical models described in Chapter 1 (i.e., Clark & Beck, 2010; Mogg & Bradley, 1998; Öhman & Mineka, 2001), when taken together, the data suggest that anxiety is characterized by an attentional bias for verbal threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. In line with Öhman's

(1993) priming hypothesis, these data suggest that priming is needed to establish selective processing of verbal threat that is presented outside of conscious awareness. However, word stimuli are relatively limited in threat value and evolutionary relevance (Mogg & Bradley, 1998), therefore the findings from studies employing words as stimuli cannot be used to make predictions about attention allocations for more ecologically valid, pictorial stimuli (e.g., snakes, threatening scenes , angry faces). Therefore, researchers have employed more ecologically valid experimental procedures to investigate selective attention to pictorial threat rather that words. The following section will discuss attentional processing of pictorial stimuli. The findings are discussed in accordance to the predictions made by the theoretical models described in Chapter 1.

General Evidence- Attentional Bias to Pictorial Threat

Studies employing various experimental paradigms have found evidence for attentional biases for pictorial threat in anxious individuals. For example, to investigate selective attention to threatening pictures of snakes and spiders in non-clinical anxiety, Öhman, Flykt and Esteves (2001) conducted three visual search experiments. In their series of experiments, a non-selected sample (Experiments 1 and 2) and non-anxious high and low fearful participants (i.e., fearful of snakes or spiders) were presented with fear relevant (snakes and spiders) and fear-irrelevant (flowers and mushrooms) target pictures embedded in a matrix of fear relevant or fear irrelevant distractors. That is, participants were presented with either a fear relevant target embedded in a matrix of fear irrelevant distractors or vice versa. A target was never presented in a matrix of the same valence category (e.g., fear relevant targets were never embedded among fear relevant distractors). In experiment 1, employing a 3 x 3 matrix, nine pictures were presented of the same valence category (target absent) or eight pictures of the same valence category with one picture (the target) of the opposite valence category (target present). In Experiment 2 and 3, the same procedure was applied but participants were presented with an additional 2 x 2 matrix containing four pictorial stimuli. The participant's task was to indicate whether the target was present or absent among the set of distractors.

The results indicated that overall, all participants were faster at detecting a fear relevant (snakes or spiders) target among fear irrelevant (flowers and mushrooms) distractors compared to fear irrelevant targets among fear relevant distractors. In addition, in Experiment 3, results indicated that fear relevance was enhanced in fearful compared to non-fearful participants. Fearful participants and controls were faster at detecting a fear relevant target that they did not fear than fear irrelevant targets, with the fearful participants demonstrating even faster detection for fear relevant targets that they feared. According to Öhman et al. (2001), an evolutionarily relevant threatening stimulus was effective in capturing attention especially if the stimulus was emotionally provocative. Others (e.g., Flykt & Caldara, 2006; Pflugshaupt, Mosimann, von Wartburg, Schmitt, Nyffeler, & Muri, 2005) found evidence for selective processing of threat among individuals with spider phobias and in spider fearful individuals (e.g., Miltner, Krieschel, Hecht, Tripp & Weiss, 2004), those with social phobia (e.g., Gilboa-Schechtman, Foa & Amir, 1999) and in HTA participants (Byrne & Eysenck, 1995). In line with all theoretical perspectives described in Chapter 1, these finding are consistent with the idea of preferential processing of threat in anxiety.

Dot Probe Studies

Attentional bias for pictorial threat in both HTA and LTA participants has also been observed across other paradigms such as the dot probe task. For example, Mogg, McNamara, Powys, Rawlinson, Seiffer and Bradley (2000) conducted two dot probe experiments with a non-clinical sample of participants. In Experiment1, below median and above median, trait anxious participants were presented with black and white pictorial stimuli on a tachistoscope, whereas Experiment 2 employed a larger sample of preselected HTA and LTA participants, determined on the basis of questionnaire scores. Participants were presented with coloured pictorial stimuli on a computer in Experiment 3. In both experiments, participants were presented with severe threat scenes (e.g., mutilated bodies, man attacking woman with knife) or mild threat scenes (e.g., soldiers holding a gun, soldiers with tanks) paired with neutral scenes (e.g., person playing a piano, healthy baby). One scene from each category appeared in the left and one in the right periphery for 500 msec. At the offset of the pictures, a dot probe was presented in the space formerly occupied by one of the pictures. Participants were required to identify the location (left or right) of the probe as quickly and accurately as possible by pressing one of two keys. RTs for identifying the probe were recorded by a stop watch.

Despite the differences in samples and stimuli employed, the results of both experiments revealed an effect of stimulus threat value. The findings of Experiment 1 revealed attentional bias for threat in both LTA and HTA groups, and the vigilance for threat increased as the threat value of stimuli increased. In Experiment 2, an additional effect of anxiety group was noted, revealing that LTA participants demonstrated attentional avoidance of mild threat but vigilance for high threat whereas the HTA participants demonstrated a general vigilance for threat and their vigilance increased as level of stimulus threat value increased. These findings are in line with others. For example, Koster, Crombez, Verschuere and Houwer (2006) also employed a dot probe task with mild and high threat scenes and found similar results to those observed in Experiment 2 of Mogg et al. (2000). That is, both HTA and LTA participants demonstrated vigilance for threat. The HTA demonstrated more vigilance for high compared to mild threat stimuli with overall greater vigilance compared to their LTA counterparts, whereas the LTA participants avoided mild threat but demonstrated vigilance for high threat stimuli. Thus, findings of both experiments revealed an effect of stimulus threat value on selective attention. If it is accepted that pictorial stimuli depicting threatening scenes carry greater threat value than verbal stimuli (e.g., threatening words) then these findings are in accord with the predictions set down by Mogg and Bradley (1998), who proposed that as intensity of threat increases, LTA individuals will orient to threat in similar ways to HTA individuals.

In sum, the aforementioned findings suggest that when participants are presented with pictures of snakes, spiders and highly threatening scenes, attentional biases to threat are observed irrespective of trait anxiety. These findings provide further support for Mogg and Bradley's (1998) theory. Attentional biases to threat in anxiety have also been observed in studies employing dot probe tasks with faces as stimuli (e.g., Bradley, Mogg, Falla & Hamilton, 1998; Mogg, Garner & Bradley, 2007; Pishyar, Harris & Menzies, 2004; Wilson & MacLeod, 2003**)**, which are thought to carry special significance for humans (Öhman, Lundqvist, & Esteves, 2001).

Pishyar et al. (2004) conducted two dot probe experiments with a non-clinical sample of high and low socially anxious participants. In Experiment 1, participants were presented with positive (e.g., happy) or negative (e.g., disgusted/ judgemental) faces paired with a neutral face in a random order with one positioned in the upper portion of the screen and the other on the lower portion of the screen. The faces were acquired by taking photographs of 100 random individuals displaying these expressions. In Experiment 2, participants were presented with neutral-neutral, positive-neutral and negative-neutral face pairs. On half of the trials the neutral face belonged to the participant. All face pairs were presented for 500 msec. At the offset, a probe ("*") was presented in the location formerly occupied by one of the faces. The findings of Experiment 1 indicated that the high socially anxious participants demonstrated an attentional bias for negative faces and attended away from positive faces while the low socially anxious participants demonstrated an attentional bias for positive faces and attended away from negative faces. In Experiment 2, when ecologically relevant faces were presented the findings replicated those of Experiment 1. These data provide evidence for selective processing of pictorial threat in social anxiety. The findings are also in line with those employing HTA samples.

For example, Bradley et al. (1998) presented HTA and LTA participants with photographs of human facial expressions depicting one of three emotions (threat, sad, happy) paired with a neutral facial expression on a dot probe task. On each trial participants were presented with emotion-neutral face pairs displayed for 500 msec on half the trials and 1500 msec on the remaining half of the trials. One face was positioned on the left side of the screen while the other was on the right. At the offset of the face pairs, a probe (: or ...) was presented in the location previously occupied by one of the faces. Participants were instructed to manually identify the type of probe by pressing one of two keys as quickly and accurately as possible. The probe remained on the screen until the software detected a response. Bradley et al., (1998) found attentional bias for threat in both groups. An investigation of the RTs revealed that the HTA participants were more vigilant for threat compared to their LTA counterparts as evidenced by faster RTs to identify the probe that replaced a threat related face compared to non-threat related faces.

Attentional biases for threat faces were also observed in a study by Mogg, Garner and Bradley (2007) who employed the dot probe task with HTA and LTA participants. The stimuli employed were pictures of male and female facial expressions depicting angry, fearful and neutral faces. Each emotional face (angry, fearful) was blended with a neutral face to create facial expressions depicting five intensities of that emotion. The intensities varied from 0%, which reflected a neutral expression, to 25%, 50%, 75% and 100%, depicting the corresponding emotion. Across the experimental trials, each intensity of each emotional face (angry or fearful) was paired with a neutral face, one presented on the left periphery of a computer screen and the other on the right for 500 msec, and replaced by a probe (: or ..). The participant's task was to use a button press to classify the probe. The findings indicated an attentional bias for the 100% negative face (angry or fearful) in the HTA group but not the LTA group.

Although these findings provide support for selective processing of threat faces as a function of trait anxiety, they cannot provide information regarding the relative influence of state anxiety in moderating these effects because these studies did not employ a state anxiety manipulation. To address this limitation, Wilson and MacLeod (2003) investigated the effect of high state anxiety on pictorial threat processing in HTA and LTA individuals.

Wilson and MacLeod (2003) employed the dot probe task with HTA and LTA participants and tested them one week prior to their end of semester exam, when state anxiety was elevated, to assess whether higher state anxiety would influence differential processing of threat between the groups. Participants were presented with five possible pairs of neutral-angry pictures of human faces on the left and right side of a screen for 500 msec. The angry faces varied in five intensities (very low anger, low anger, moderate anger, high anger, very high anger) and were proportionately presented across the trials and across left vs. right screen positions. At the offset of the face pairs, a probe ("/" or "\") replaced one of the faces. Probe presentation was equally distributed on the left and right side of the screen across trials. The participant's task was to identify the slope of the probe as quickly and accurately as possible. The results indicated that both HTA and LTA participants directed their attention away from faces depicting mild anger but attended toward more intensely angry faces. The data also revealed that trait anxiety was associated with the intensity of threat required to produce vigilance toward threat stimuli. That is, more anger was needed to produce vigilance in LTA and less anger to produce vigilance in HTA participants. In sum, if pictorial threat (e.g., angry faces) carries more threat value than verbal threat (e.g., threat related words) then these findings support the predictions of Mogg and Bradley (1998) in that they suggest that as threat value increases LTA individuals will selectively attend to threat in similar ways as HTA individuals. Moreover, elevations in state anxiety may have contributed to the attentional avoidance of mild threat in the HTA group compared to the vigilance observed in previous studies. However, the overall relative influence of state anxiety in distinguishing the processing of threat faces between the HTA and LTA participants in unknown because the study did not include a low state anxiety condition for comparison.

Section Summary

Consistent with the theoretical models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) the aforementioned findings provide evidence for the prediction that anxiety is characterized by an attentional bias to threat. These findings are also in line with the more specific predictions proposed by Mogg and Bradley (1998) who suggested that as threat intensity increases, LTA individuals will attend to threat in similar ways as HTA individuals. However, a limitation of the aforementioned studies is that participants were presented with stimuli that they were consciously aware of, therefore these findings cannot provide information for the without awareness component of the automaticity hypothesis as proposed by the theoretical models described in Chapter 1. The following section will discuss finding from studies that employed backward masking procedures as a way of preventing conscious awareness of pictorial stimuli.

Automaticity - Attentional Bias to Pictorial Threat without Awareness

Dot Probe Studies

To assess whether attentional biases for pictorial threat operate prior to conscious awareness, Lee and Knight (2009) employed a masked version of the dot probe task with young and older non-clinical samples with low, moderate and high trait anxiety. Participants were presented with pairs of angry-neutral, happy-neutral and sad–neutral faces as well as high threat–non-threat IAPS pictures (i.e., pictures depicting scenes) and negative-neutral word pairs. On the unmasked trials the stimuli were presented for 1500 msec at which point they were replaced by a probe, whereas on the masked trials the paired stimuli were presented for 20 msec (younger adults) and 50 msec (older adults) and replaced by a mask for the same durations. At the offset of the mask, a dot probe replaced one of the stimuli. Participants were instructed to manually respond to the position of the probe as quickly and accurately as possible. The results revealed that younger adults did not display any processing biases and across all participants there were no differences in processing the pictures of scenes versus words. Irrespective of trait anxiety older adults demonstrated vigilance for masked angry faces but avoidance of unmasked angry faces. The findings further indicated that masked vigilance and unmasked avoidance for sad faces was associated with moderate anxiety. For negative words however, the findings indicated avoidance of masked negative words and vigilance for unmasked negative words in the high anxiety groups. In considering the theoretical models described in Chapter 1, the vigilance for masked pictorial threat compared to the avoidance of masked verbal threat may suggest that faces (especially angry faces) may carry a greater threat value than threat words. However, in line with Öhman's priming hypothesis, the difficulty with attributing automatic preconscious processing to threat when masked and unmasked trials are intermixed is that it is possible that the presentation of threat on unmasked trials may have primed the mechanisms responsible for detecting subliminal threat.

Mogg and Bradley (2002) employed a masked only version of the dot probe task with pictorial face stimuli. A non-clinical sample of participants was assigned to a trait anxiety group (high trait anxiety vs. low trait anxiety) and a social anxiety group (high social anxiety vs. low social anxiety) on the basis of questionnaire scores. Participants were presented with pairs of happy-neutral and threat-neutral faces for 17 msec which were replaced by a mask (defragmented neutral face features) for 68 msec. At the offset of the mask, a probe (: or ...) appeared in the location formerly occupied by one of the masks. Participants were instructed to manually identify the probe as quickly and accurately as possible. Awareness checks confirmed that participants were unaware of masked stimuli. The results failed to find any differential threat processing effects between the HTA and LTA participants. The data for the socially anxious participants revealed that high socially anxious participants were faster at detecting probes that replaced masked threat faces compared to masked neutral faces, whereas the low socially anxious participants took longer to respond to probes that replaced masked threat relative to neutral faces. The differential findings between the trait anxious and socially anxious participants may suggest that socially anxious individuals may have a lower perceptual threshold for masked threat faces. Alternatively, the non-significant finding in the trait anxious participants could be attributed to the lack of state anxiety manipulation, which has been associated with masked threat processing effects for verbal stimuli and is central to the theoretical models of Mogg and Bradley (1998) and Öhman and Mineka (2001).

To investigate whether attentional biases for pictorial threat operate prior to conscious awareness, Mogg and Bradley (1999a) conducted two masked versions of the dot probe task (Experiment 1 and Experiment 3) by presenting HTA and LTA participants with masked and unmasked picture pairs of angry-neutral, happy-neutral human faces. To control for possible priming effects, masked trials were always presented before the unmasked trials. All face pairs were presented briefly for 14 msec and at the offset they were replaced by a mask consisting of a face with randomly re-assembled facial images. Awareness checks were conducted by way of forced choice discrimination task (male face vs. female face). In Experiment 1, despite being unaware of the set of masked stimuli, participants, irrespective of trait anxiety, were faster at detecting probes that replaced threatening faces relative to neutral and happy faces. In Experiment 3, similar findings emerged. However, selective attention to threat was greater in the HTA relative to the LTA participants. According to Mogg and Bradley, the differing results between Experiments 1 and 3 could be attributed to procedural differences. That is, in Experiment 1, a dot probe location task was employed, whereas Experiment 3 employed a probe classification task. Mogg and Bradley further noted that the LTA compared to the HTA group reported higher levels of state anxiety in Experiment 1 that were not evident in Experiment 3. Elevations in state anxiety in the LTA group in Experiment 1 could be the moderating factor responsible for eliciting similar masked threat processing patterns as those evidenced in the HTA group.

In summary the data from Mogg and Bradley (1999a) and Lee and Knight (2009) provide evidence to suggest that without conscious awareness both HTA and LTA as well as high socially anxious but not low socially anxious individuals display attentional bias toward masked threat faces. However, the findings of Mogg and Bradley's (1999a) study, particularly in relation to the LTA participants, should be interpreted with caution because it is unclear whether state or trait anxiety moderated the attentional biases for masked threat faces. Nonetheless, these findings provide support for the without awareness component of the automaticity hypothesis proposed by all theoretical models described in Chapter 1. In assessing attentional biases to pictorial threat all of the aforementioned studies employed the visual search and dot probe tasks. Despite the effectiveness of these tasks to provide measures of attentional allocation (see Chapter 2) these experimental paradigms do not assess any disruptions in task performance because individuals may allocate attentional resources toward threat stimuli before they are required to respond to the location or to classify the probe, or to detect a target among distractors. Further, because these tasks do not allow for assessment of competition for attention, they cannot provide an evaluation for the 'without volition' component of automaticity which is central to all models described in Chapter 1. The following section will discuss findings from studies employing the emotional Stroop colour naming task, which is capable of a assessing for both components of the automaticity hypothesis.

Automaticity - Attentional Bias to Pictorial Threat without Volition

At this time, only four studies with adult samples could be found that employed the emotional Stroop interference task to assess for the involuntary nature of selective attention for pictorial threat in non-clinical anxiety, and only two are capable of providing information regarding the without awareness component of selective attention for pictorial threat. Avram, Balteş, Miclea and Miu (2010) employed a variant of the emotional Stroop colour naming task with extremely high and extremely low trait anxious (TA) individuals. Allocation to trait anxiety group was done on the basis of a Romanian version of the State-Trait Anxiety Inventory (Pitariu & Paleasa, 2007; Spielberger, 1983). HTA and LTA participants were presented with Ekman pictures (Ekman & Friesen 1976) of human faces depicting happy, neutral or fearful expressions overlaid with a word ("happy", "calm" or "fear"). Stimuli were either congruent (e.g., fear face overlaid by the word "fear") or incongruent (e.g. happy face overlaid by the word "fear"). Contrary to the traditional emotional Stroop task where participants are required to name the colour of the stimulus, in the Avram et al. experiment the participant's task was to identify the emotion of the face while ignoring the semantic content of the word that overlaid the face as quickly and accurately as possible. In line with Williams, Mathews and MacLeod (1996) attentional bias scores were calculated for congruent and incongruent conditions by subtracting the mean RT for identifying neutral faces from mean RT for classifying fearful faces (aversive bias) and happy faces (appetitive bias). Positive RTs reflected threat facilitation whereas negative RTs reflected threat interference. The findings revealed that HTA relative to LTA participants demonstrated a facilitated attentional bias to fearful faces relative to happy faces. That is, HTA relative to LTA participants were faster to identify the fearful faces compared to the happy faces despite the presence of valence congruent and incongruent distracting information. These findings therefore suggest that anxiety is characterized by a facilitated attentional bias to fearful stimuli.

In a similar experiment, Robson, Letkiewicz, Overstreet, Ernst and Grillon (2011) investigated the extent to which state anxiety moderated selective processing of threat in a non-selected sample of participants. Robson et al. (2011) employed a variant of the Stroop colour naming interference task. In this task, participants were presented with Ekman pictures of human faces (Ekman & Friesen, 1976) depicting a happy or fearful expression overlaid with a word (“happy”/”fear”). Stimuli were either congruent (e.g., fear face overlaid by the word “fear”) or incongruent (e.g., happy face overlaid by the word “fear”). On half of the trials participants performed under the threat of shock versus under shock safe conditions for the remaining trials. Shock intensity was individually determined prior to the experiment to a level that was uncomfortable but not painful. The procedure consisted of a 1000 msec presentation of the stimuli followed by a 3000-5000 msec (mean of 4000 msec) ‘jitter’ of the stimuli and replaced by a fixation cross. Participants were instructed to read the word that overlaid the face while ignoring the expression of the face. Averaged over the congruent and incongruent conditions, the findings of this study revealed attentional bias toward threat faces in the shock threat condition. That is, despite instructions to ignore the face, participants took longer to read a word that overlaid a threat related face compared to a neutral face when performing under the threat of shock. These findings suggest that the presence of threat faces interfere with the central task (word reading).

The findings of both studies revealed increased attentional bias in processing of threat faces relative to non-threat faces (Avram et al., 2010; Robson et al., 2011) as a function of increased anxiety. These findings suggest that the involuntary nature of selective processing of pictorial and verbal threat is moderated by anxiety. However, these data do not indicate how state and trait anxiety might interact to moderate these effects. Robson et al. (2011) did attribute the increase in state arousal (e.g., shock threat condition) as a partial representation of anxiety levels in those with GAD and panic disorder.

In sum, these findings suggest that both state and trait anxiety moderate the selective attention for threat faces. Avram et al. (2010) found that HTA relative to LTA individuals selectively attended to threat faces relative to non-threat faces but they did not investigate the role of state anxiety in moderating these effects. Alternatively, Robson et al. (2011) manipulated state anxiety and found that selective attention for threat faces relative to non-threat faces was noted in the high state anxious group relative to the low state anxiety group. However, Robson et al. could not provide any information regarding the influence of trait anxiety in moderating these effects. Further, despite the opposite task demands (e.g., name face vs. read word) the HTA or high state anxious participants' attention was captured by the threat related face not the threat related words. These findings suggest that faces may carry more threat value than words, and an increase in either state or trait anxiety can elicit attentional bias for threat faces. However, a limitation of the aforementioned studies is that they cannot assess for the 'without awareness' component of the automaticity hypothesis because all stimuli were presented within conscious awareness. Therefore, the following section will discuss studies that have employed masked faces on the emotional Stroop task.

Automaticity - Attentional Bias to Pictorial Threat without Volition and Awareness

The pre-attentive processing of threat was investigated by van Honk, Tuiten, de Haan, van den Hout and Stam (2001) who employed the emotional Stroop colour naming task with HTA and LTA participants by presenting them with masked and unmasked Ekman faces (Ekman & Friesen 1976) displaying neutral and threatening facial expressions in red, green, blue and yellow colouring. All masks consisted of faces with reassembled facial features which were presented in the same colour as the preceding face. The SOA between the target and the mask was 30 msec for all participants. An affective discrimination task (i.e. neutral vs. emotional expression) was used as an awareness check to ensure that masking procedures were effective in preventing awareness of stimuli. The participant's task was to name the colour of the face as quickly and accurately as possible while ignoring the emotive content of the stimulus. The RT data failed to produce any significant evidence for selective attention to threat for either exposure mode or trait anxiety group. These finding are at odds with studies that found selective processing of threat on unmasked (Bradley et al., 1998; Bradley et al., 1999; Bradley et al., 2004; Koster et al., 2006; Lee & Knight, 2009; Mogg et al., 2000; Mogg et al., 2007; Waters et al., 2004; Waters et al., 2008; Wilson & MacLeod, 2006) and masked trials (Bradley et al., 2004; Lee & Knight, 2009; Mogg & Bradley, 1999a).

Similar findings were obtained by Putman, Hermans and van Honk (2004) who also employed the emotional Stroop colour naming task with a non-selected sample of participants. In their study, happy, angry and neutral faces were presented in various colouring (red, blue, yellow). Ekman faces (Ekman & Friesen, 1976) were employed for the happy and angry faces while the neutral faces were derived from Lundqvist, Flykt and Öhman (1998). Participants received either masked (25 msec) trials first followed by unmasked trials or the reverse order. Forced choice awareness checks (identify face as happy, neutral or angry) were conducted to ensure that masking procedures were effective in preventing awareness of stimuli. The results also failed to reveal any significant selective processing of threat faces as a function of trait anxiety in either exposure mode. The findings did reveal selective processing for masked angry faces compared to the masked neutral faces as a function of social anxiety.

In summary, the findings of van Honk et al. (2001) and Putman et al., (2004) failed to provide evidence for selective processing of pictorial threat in trait anxious individuals. However, the findings of Putman et al. (2004) did reveal masked threat processing effects in the socially anxious group. Taking into consideration that these findings were observed irrespective of whether masked trials or unmasked trials were presented first, it may be that socially anxious participants do not rely on priming to elicit involuntary attentional bias for pictorial threat. These findings are at odds with Öhman's (1993) priming hypothesis which suggests that priming is a precursor for eliciting selective processing of threat outside of conscious awareness.

When taken together, these data provide conflicting support for the central predictions made by the models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) who proposed that anxiety is characterized by an attentional bias to threat and this bias is automatic in that is involuntary and occurs outside of conscious awareness. Of significance, the aforementioned studies were problematic for providing support for the without awareness component of the automaticity hypothesis due to a number of methodological limitations. First, von Honk et al. (2001) and Putman et al. (2004) employed backward masking procedures with HTA and LTA participants but they failed to produce any significant differences in processing of threat faces on both the masked and unmasked trials. These findings were surprising given that other studies employing the emotional Stroop task have found vigilance for pictorial threat on unmasked trials as a function of trait anxiety (Avram et al., 2010) and state anxiety (Robson et al., 2011). Others have employed dot probe tasks and found vigilance for pictorial threat in non-anxious controls, and non-clinical trait anxious participants, on unmasked (Bradley et al., 1998; Bradley et al., 1999; Koster et al., 2006; Lee & Knight, 2009; Mogg et al., 2000; Mogg et al., 2007; Waters et al., 2004; Waters et al., 2008; Wilson & MacLeod, 2006) and masked trials (Bradley et al., 2004; Lee & Knight, 2009; Mogg & Bradley, 1999a). The findings from Putman et al. (2004) and Mogg and Bradley (2002) do provide some evidence of preconscious processing of pictorial threat in nonclinical socially anxious individuals and evidence against Öhmans'(1993) priming hypothesis.

A number of methodological limitations with von Honk et al. (2001) and Putman et al. (2004) could have contributed to the discrepant findings. The failure to find unmasked stimulus effects in both van Honk et al. (2001) and Putman et al.'s (2004) studies, in comparison to the selective processing of threat faces that were observed in Avram et al. (2010) as a function of extremely high trait anxiety, and in Robson et al. (2011) as a function of increased state anxiety, could be a result of the different stimuli used and differences in task demands employed. Both Van Honk et al. and Putman et al. employed pictures of faces in various colours with the task being to identify the colour of the faces, whereas Avram et al. and Robson et al. employed pictures of faces overlaid with emotionally toned words with the task being to either identify the facial expression or to read the word. Perhaps when emotional words are presented with emotional faces such stimuli can activate increased arousal compared to when faces are simply presented in various colours. It could also be that if word reading and identifying a face are considered to be more complex tasks than identifying a colour, then the complexity of task could have contributed to an increase in arousal, making the outcomes in line with Öhman and Mineka's (2001) theory which places more emphasis on state anxiety than trait anxiety in moderating attentional biases to threat in anxiety. Given that state anxiety was not manipulated or even assessed in any of the studies with the exception of Robson et al. (2011), who found an effect of state anxiety, that possibility cannot be discounted.

Previous studies employing the emotional Stroop task with words (e.g., MacLeod & Rutherford, 1992) and dot probe studies employing pictorial stimuli (e.g., Mogg & Bradley, 1999a; Wilson & MacLeod, 2003) found that elevated levels of state anxiety may be necessary for producing selective effects for threat processing. If the involuntary nature of attentional biases to threat faces is moderated by state anxiety then this could be a possible explanation for the lack of significant threat processing biases in the studies of van Honk et al. (2001) and Putman et al. (2004). Because they did not interpret their results on the basis of state anxiety, it is possible that their samples were characterized by lower state anxiety. Alternatively, as Avram et al. (2010) only found significant effects in their extremely high trait anxious sample, it could be possible that Avram et al., (2010) employed a sample characterized by higher state anxiety. Therefore, if selective processing of threat faces is a function of elevated state anxiety then this would provide support for Öhman and Mineka's (2001), and partial support for Mogg and Bradley's (1998), theoretical perspectives. Both theoretical models predict that elevated state anxiety moderates selective processing of threat in trait anxious individuals.

Second, both studies implemented considerably long SOA of 30 msec and 25 msec on masked exposure trials. Experiments with shorter SOA have demonstrated selective attention for masked face stimuli (e.g., 14 msec, Harvey et al., 1996; 20 msec, MacLeod & Rutherford, 1992; 14 msec & 17 msec, Mogg & Bradley, 1999a, Experiment 1 & Experiment 3, respectively; 14 msec, Mogg et al., 1993). Interestingly, some findings suggest that pre-conscious effects become less evident when stimuli are presented closer to awareness threshold levels (Mogg & Bradley, 1999a). As such, the longer SOA employed by van Honk et al. (2001) and Putman et al. (2004) could have impeded any selective processing effects for masked pictorial threat stimuli. However, it should be noted that Lee and Knight (2009) employed 50 msec SOAs with older adults and found masked effects.

On the emotional Stroop task van Honk et al. (2001) and Putman et al. (2004) did not find differential processing effects as a function of trait anxiety. However, Putman et al. (2004) did find attentional biases for masked threat faces compared to neutral faces in a non-clinical socially anxious group. It could be the case that the involuntary nature of selective attention for subliminally presented faces is unique to social anxiety. Similarly, on the dot probe task, Mogg and Bradley (2002) also found selective processing of masked threat faces in their non-clinical socially anxious sample but not in their trait anxious sample. Perhaps socially anxious individuals are more sensitive to detecting threatening faces because facial features are a vital social signal (Öhman, 1986). Furthermore, perhaps the samples employed on the dot probe task by others (e.g., Bradley et al., 2004; Lee & Knight, 2009; Mogg & Bradley, 1999a) who have found selective processing of masked threat faces had high social anxiety in addition to trait anxiety. This would be consistent with the notion that vigilance for emotional facial expressions played a critical role in the biological evolution of humans (Dimberg & Öhman, 1996) and the emotionally toned facial features may be prototypes of biologically prepared stimuli (Lundqvist, Esteves & Öhman, 1999). However, given that only two studies could be found that have investigated involuntary and without awareness components of automaticity with pictorial stimuli while controlling for priming with trait anxious participants, the discrepancies between studies might be explained by the previously mentioned limitations.

Lastly, attentional biases for faces may be identified on more ecologically valid tasks, like the dot probe task. That is, although the emotional Stroop task has been a widely used paradigm for the purpose of investigating attentional patterns in anxiety (see Chapter 2), it is ecologically unlikely that a person will be required to ignore a threat stimulus when looking directly at it. However, a limitation of the dot probe task is that is it not capable of investigating the involuntary nature of automaticity. Alternatively, the Flanker task corrects for this limitation by spatially separating the to-be-attended to and the to-be-ignored stimuli (see Chapter 2) while still being capable of assessing for the involuntary nature of automaticity.

Summary – Pictorial Stimuli

The aforementioned findings provide mixed support for the models described in Chapter 1. Although there is compelling evidence in support of the selective processing of pictorial threat as a function of anxiety, it is unclear whether these processes are in fact automatic in that they are involuntary and occur outside of conscious awareness. It is also unclear whether these biases to selectively process pictorial threat are moderated by trait or state anxiety. The findings are also mixed for Öhman's (1993) priming hypothesis. Given the limited number of studies that have employed stringent criteria to assess for these variables, research capable of employing such control is warranted.

Further, the theoretical perspectives described in Chapter 1 have been devised on the basis of empirical studies that have employed methodologies that do not allow for a rigorous investigation of the mechanisms involved in the automaticity of threat appraisal. For example, these models propose that attentional bias to threat is automatic in that it is involuntary and occurs outside of awareness; however, the pool of research that forms the basis of this work has not controlled for the possibility that participants may have been primed for threat on masked trials when presented with an intermixed sequence of masked and unmasked trials. Therefore, if this is the case, attentional biases may not be completely automatic, but may rely on priming or some level of awareness to produce these effects. Further, these theories are largely based on methodologies that do not allow for an investigation of the volition component of automaticity. Based on these gaps in empirical literature the following series of studies employed tight procedural controls focusing mainly on the automaticity of attentional biases to threat in anxiety.

Introduction to the Research Program

The objectives of the thesis were to employ interference paradigms to provide a systematic investigation of attentive and preattentive allocation for spatially integrated verbal threat (e.g., threat words) in clinically anxious and non-clinical HTA and LTA individuals on an emotional Stroop colour naming task with an emphasis on the role of priming in moderating preattentive processing of verbal threat. Although there is considerable literature investigating selective processing for verbal threat in both clinical and non-clinically anxious samples, to date, no known study has employed interference paradigms with non-clinically anxious participants and included a clinical sample for comparison. Therefore, the current research programme includes one such study. The present investigation also extends to attentive and preattentive allocation of more ecologically valid, spatially integrated (emotional Stroop colour naming task) and spatially separated (Flanker task) threat stimuli (i.e., faces) in non-clinical HTA and LTA individuals with an emphasis on investigating the role of priming in moderating preattentive processing of pictorial threat. In order to achieve this, care was taken to control for a number of potential limitations in the current body of research literature.

Task Demands

The series of studies employed in the current thesis were restricted to interference paradigms. Interference paradigms were chosen because they are capable of assessing both the involuntary and without awareness components of automaticity in the selective processing of threat in anxiety. In studies 1, 2.1 and 2.2, an emotional Stroop colour naming task was employed, whereas the Flanker task was employed in studies 3.1 and 3.2. The differential component of these two tasks is that while the emotional Stroop colour naming task presents the to-be-attended-to (colours) and the-to-be-ignored (faces) stimuli as an integration of two features into the same stimulus, the Flanker task spatially separates the to-be-attended-to stimuli (probes) and the-to-be-ignored stimuli (faces). Because these stimuli are presented simultaneously and participants are asked to attend to one stimulus while ignoring the other, the structure of the task creates competition for attention and therefore is appropriated for assessing the involuntary component of automaticity.

Stimuli

Study 1 employed words as stimuli that varied in valence such that half the words were threat related and half were non-threat related control words, matched for average length and frequency. Masks for use in Study 1 consisted of a random string of upper case letters matched on average length. Studies 2.1, 2.2, 3.1 and 3.2 employed schematic representations of happy, neutral and angry facial expressions. Masks for use in pictorial studies consisted of a facial shape with a random application of facial features from all three valence groups displaced within the outline of the face. In studies 1, 2.1 and 2.2 employing the emotional Stroop colour naming task, words, faces and masks were presented in one of four colours (red, green blue or yellow).

Stimulus Exposure

To assess the hypothesis that selective processing of threat occurs outside of conscious awareness, in each study half of the stimuli were presented masked and half unmasked. In Study 2.2 and 3.2 the masked and unmasked stimuli were presented in an intermixed sequence. To assess the hypothesis that priming is needed to activate selective processing of threat on masked trials, Studies 1, 2.1 and 3.1 blocked on exposure by presenting half the participants with two blocks of masked trials first followed by two blocks of unmasked trials, while the other half of participants received the opposite order. On blocked studies (Studies 2.1 and 3.1 not including Study 1), in line with previous literature, the SOA was pre-determined at 15 msec to prevent the possibility of SOA priming responses on experimental trials. Previous studies have shown that short SOAs have demonstrated selective attention for masked face stimuli (e.g., 14 msec, Harvey et al. 1996; 20 msec, MacLeod & Rutherford, 1992; 14 msec & 17 msec, Mogg & Bradley, 1999a, Experiment 1 & Experiment 3, respectively; 14 msec, Mogg et al., 1993). To assess awareness, participants underwent an awareness check procedure which was implemented to exclude any participants who may have been aware of masked content throughout the experiment. In Study 1, awareness was assessed by way of a lexical decision task (word/non-word). For the remainder of the studies incorporating schematic faces as stimuli (Studies 2.1, 2.2, 3.1 and 3.2) the awareness check procedure was an equivalent face/non-face discrimination task.

Anxiety Groups

Clinically anxious participant were employed in Study 1. They were referred by various medical practices and had a current diagnosis of an anxiety related disorder, mainly GAD. The non-clinically anxious group employed across all studies included high trait anxious (HTA) and low trait anxious (LTA) participants.   Allocation to a trait anxiety group was made on the basis of questionnaire scores on the State-Trait Anxiety Inventory-Trait measure (STAI-T; Spielberger, Gorsuch & Lushene, 1970; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983). Chapter 3 describes the psychometric properties of the STAI-T and trait anxiety group assignment criteria. In non-clinically anxious participants, state anxiety was manipulated through the threat of electric shock. This technique was chosen because it reflects a current stressor and has been shown to be an effective technique for altering current mood states (see Edwards, Burt & Lipp, 2006, 2010a, 2010b).

Initial Screening Criteria

To adhere to the requirement of task demands, only participants who reported normal or corrected to normal vision, normal colour vision and English as their primary language (Study 1 only) were included in the series of experiments. Also, for ethical reasons, only those who reported no cardiac conditions, were aged between 18 and 65 years and reported within criterion on depression scores on the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961, Study 1) and the Depression, Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995, Study 2.1, 2.2, 3.1, 3.2) participated in the experimental phase of the series of studies. Further, only those who reported low social desirability on the Marlowe-Crowne Social Desirability Scale (MCSDS; Marlowe & Crown, 1960; Strahan & Gerbasi, 1972) were included in the series of experiments. The inclusion and exclusion criteria and psychometric properties of all relevant measures will be discussed in Chapter 3.

There is evidence to suggest that HTA individuals demonstrate an involuntary selective processing of masked threat. However, a number of studies have failed to report such effects (e.g., van Honk et al. 2001; Putman et al. 2004). Although the reasons for the discordant findings are unknown, it is possible that person variables such as high levels of depression and social desirability may be a moderating variable for these differential findings. For example, Bradley, Mogg, Miller and White (1995) employed the emotional Stroop colour naming task with a sample of GAD, mixed GAD and depression disordered (DEP) and non-anxious participants with masked and unmasked depression related and anxiety related words. The findings indicated that GAD participants relative to non-anxious controls demonstrated an attentional bias to masked and unmasked threat related words relative to non-threat related words. However, on masked trials, the GAD group relative to the mixed GAD/DEP group demonstrated an attentional bias for threat words relative to neutral words. Given the discrepant processing of threat words between the GAD and mixed GAD/DEP participants, it is plausible that depression masked the processing of subliminal threat information in the latter group. Given this possibility and the high comorbidity between anxiety and depression (Hirschfeld, 2001**)** in the community, the current series of studies controlled for depression scores. The inclusion of the social desirability screen in the current series of studies was deemed important because it has been suggested that low trait anxious participants who report high social desirability demonstrate similar selective threat processing patterns to highly anxious individuals (e.g, Dawkins & Furnham, 1989).

Chapter Summary

In this chapter evidence for attentional biases to verbal and pictorial threat in clinical and non-clinical anxiety was reviewed and critically evaluated. The main focus was to evaluate evidence for the automatic nature of threat processing; that is, the extent to which attentional biases to verbal and pictorial threat are involuntary and occur outside of conscious awareness with a particular focus on the role of priming. The influences of state and trait anxiety in moderating these effects was also reviewed. Based on this review a number of methodological limitations that contribute to interpretational difficulties were identified. The chapter concluded with a proposed research programme tailored at addressing some of the limitations of previous work. Details on the general methodology employed throughout the series of studies are described in Chapter 3.

Chapter 3

General Methodology

Participants

After meeting all screening criteria, data from 544 participants from Bond University and the wider Gold Coast community were included in the final analyses across five studies. As an incentive to participate, students received a credit point toward an introductory psychology class, community members received $ 25 AUD for participating and clinical participants were entered into a draw to win a $ 100 AUD gift voucher. All participants were tested individually on all measures and experimental tasks in a computer laboratory. Testing time was between 45- 50 minutes for each participant. Upon arrival to the laboratory, all participants completed a voluntary informed consent form. Participant eligibility screening criteria were reviewed with each participant

Screening for eligibility was structured on three levels. Participants were invited to participate if they reported being between 18 and 65 years of age, English was the first language they learned as a child, they had normal or corrected to normal vision and normal colour vision, and if they had no history of a cardiac condition. Participants with cardiac dysfunction were excluded at the request of the local ethics committed given the exposure to shock implemented in the proposed series of studies. Information about participants who were excluded on the basis of these criteria is described under the ‘Participants’ section in each empirical chapter (i.e., Chapters 4, 5 and 6). Participants who met the initial screening criteria completed a series of questionnaires (see below) and the experimental tasks. Following previous work (i.e., Edwards, 2014), a number of participants whose scores on the questionnaires or performance on the tasks exceeded criteria were excluded. Exclusion details for those participants are described in the relevant chapters.

Facilities and Apparatus

Facilities

All testing and data collection was carried out in the Cognitive Psychology Lab housed in the School of Psychology at Bond University.

Apparatus

Experimental hardware. All word, face, digit and shape stimuli were presented on a Dell OptiPlex GX520 Pentium 4 computer running at 866 MHz, using a Video Stimulus Generator video card (VSG; 2-3 issue 4a) capable of refresh rates up to 500 Hz (2 msec) and a Hitachi Superscan 813 21-inch colour monitor with a vertical refresh rate of 200 Hz (5 msec). Responses on the threshold setting trials, awareness check trials and distracter tasks were done on a keyboard that was attached to the computer. This keyboard contained clearly labelled buttons for WORD, FACE and ODD digit (left arrow) and NON – WORD, NON-FACE and EVEN digit (right arrow) stimuli. Details on word/non word trials are provided in Study 1 (Chapter 4). For details on face/non-face trials see Study 2.1, 2.2, 3.1 and 3.2 (Chapters 5 & 6) and for details on Odd/Even trials see Study 3.1 and 3.2 (Chapter 6). For collecting colour and probe response latencies, participants wore a headset microphone that was connected to the computer.

Experimental software. Purpose written experimental software controlled the presentation of stimuli on the SOA threshold setting trials, awareness check trials, practice trials and experimental trials. The software recorded colour naming reaction times, errors and microphone failures.

Electric hardware. A 200 msec electric shock was delivered by a Grass SD9 (0-90V) stimulator to the volar surface of the participant’s left arm through a 35 mm diameter concentric stainless steel electrode which was secured by a velcro cloth strap. A sponge soaked in saline was secured on the electrode and used for the electrode to skin contact. The shock intensity varied from 0 volts to 90 volts and was set individually for each participant to a level that was uncomfortable but not painful.

Stimulus Materials

Word Stimuli

The word stimuli used in Study 1 were derived from Edwards, Burt and Lipp (2006). However, no differentiation on the basis of threat specificity was made in the current experiment. Word stimuli were divided into two groups consisting of 80 threat related and 80 neutral words matched for average length (M = 6.63 and M = 6.56 letters, respectively) and frequency of use (M = 21.81 and M = 22.23, respectively; both $F < 1$, *ns)*. The frequency counts were derived from the British National Corpus of approximately 89 million words (BNC; Kilgarriff, 1998). For counterbalancing purposes, the threat related and neutral words were divided into two 80 words lists (A and B), and each list contained 40 threat related words and 40 control words matched for average length and frequency. Each word stimulus was presented in one of four colours (red, green, blue or yellow). Table 3.1 shows the word sets used in the colour naming trials.

Table 3.1

Stimulus Words with Frequencies in Parentheses applied to Study 1

Set A		Set B	
Threat	Matched Controls	Threat	Matched Controls
Burn (1559)	Fence (1502)	Burnt (1100)	Cups (1173)
Cable (1863)	Bench (1869)	Charge (9528)	Glass (9369)
Charred (185)	Ottoman (328)	Circuit (2552)	Ceiling (2184)
Current (13599)	Computer (12964)	Danger (5709)	Coffee (5724)
Electrical (2136)	Newspapers (3332)	Electricity (3476)	Comfortable (3718)
Electrify (14)	Bedspread (62)	Electrocute (0)	Furnishings (404)
Electrode (122)	Appliance (157)	Fear (8689)	Step (8313)
Frightened (2408)	Photograph (2462)	Generator (401)	Cupboards (442)
Hazard (829)	Illness (3118)	Hurt (4145)	Desk (4209)
Intense (2303)	Crystal (2062)	Lethal (626)	Fridge (652)
Lightening (480)	Typewriter (416)	Pain (6928)	Chair (6969)
Painful (1823)	Washing (2070)	Polarity (116)	Crockery (121)
Scar (411)	Taps (434)	Shocking (534)	Dwelling (538)
Shocks (346)	Saucer (308)	Singed (45)	Laundry (52)
Sparks (418)	Sponge (419)	Spasm (184)	Eaves (183)
Sting (552)	Towel (794)	Stinging (504)	Cushion (435)
Voltage (837)	Basement (792)	Volt (97)	Hinge (194)
Wires (656)	Bowls (639)	Watts (450)	Apron (453)
Wound (2062)	Cloth (1823)	Wiring (364)	Trough (305)
Zapped (20)	Soaped (15)	Unpleasant (1255)	Apartment (1272)
Abuse (3389)	Sugar (3365)	Amputate (11)	Latticework (13)
Cancer (4023)	Bottle (3634)	Coffin (1317)	Carpet (2088)
Dead (11643)	Wall (11180)	Deceit (205)	Blinds (269)
Diseased (178)	Linoleum (117)	Disgraced (178)	Brickwork (266)
Dumb (667)	Rack (696)	Embarrass (195)	Wardrobes (113)
Evil (2745)	Beds (2038)	Fail (3238)	Bath (3318)
Grief (1315)	Suite (1322)	Hate (2390)	Keys (2095)
Hateful (105)	Archway (190)	Humiliate (112)	Fireplace (689)
Illness (3118)	Bedroom (3674)	Inadequate (2263)	Furniture (3204)
Incompetent (350)	Mantelpiece (298)	Infection (2654)	Doorway (1619)
Kill (4375)	Iron (4375)	Lacking (1479)	Blanket (1061)
Lonely (1696)	Garage (1603)	Massacre (621)	Spacious (653)
Murder (5781)	Cabinet (6347)	Mutilation (92)	Dishwasher (170)
Pathetic (625)	Lavatory (549)	Peril (289)	Settee (244)
Punishment (2211)	Decoration (914)	Sadness (754)	Shelves (1115)
Satan (375)	Stair (339)	Snake (718)	Spoon (706)
Stupid (2439)	Sheets (2127)	Starve (247)	Opener (263)
Tumour (879)	Bucket (848)	Torture (863)	Curtain (1297)
Violence (5350)	Pictures (5057)	Ugly (1252)	Hook (1303)
Worry (4516)	Doors (4383)	Spider (1272)	Pillow (666)

SOA threshold trials presented a set of 200 neutral English words, matched for average length and frequency with those used in the colour naming trials, in lowercase letter strings; in addition 200 non-words in English were presented consisting of a random sting of upper case letters. Each word/non-word was in the range of 4 to 11 characters matched for average length within and between threshold setting blocks. Forty word/non-word stimuli from the SOA threshold setting trials were used in the final awareness check trials.

The practice trials used a set of 40 neutral words also matched for length and frequency with those stimuli used in the experimental trials. All word and non-word stimuli were presented in characters approximately 1cm high.

Face Stimuli

All schematic representations of face, non-face and mask stimuli used in the SOA setting trials (Study 2.2 and 3.2 only), colour naming trials and final awareness check trials were developed in accordance with those used in the visual search paradigm by Öhman, Lundqvist and Esteves (2001). The face stimuli (happy, neutral and threat) are shown in Figure 3.1. These stimuli were created using a 3 pixel line on a standard computerized paint program. An oval approximately 60 mm high X 50 mm wide was created to represent the outline of the face. Two ears were drawn and positioned to each side of the face. To create the happy face, two eyebrows slanted upwards in the centre, two semi-circle eyes, one triangle nose and one bottom curved mouth were drawn inside the face. To ensure that the faces matched on features, the threat faces was created from the features of the happy face, specifically, by inverting the mouth and the eyes and by switching the left and right eyebrows so to slant down in the middle. When designing the neutral face, the face outline, the triangle nose and the two ears were used as in the happy and threat faces, however, the eyebrows were replaced by two horizontal lines above the eyes (rather than two slanted lines), the eyes were replaced with two horizontal ovals (rather than two semicircles) and the mouth was again a horizontal line (rather than a curved line). All stimuli were matched for line thickness (3 pixels) and luminance.

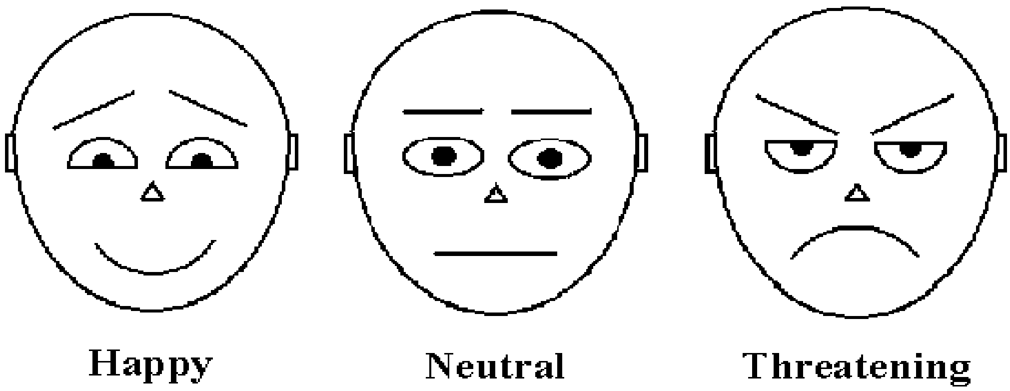

Figure 3.1. Stimuli of happy, neutral and threat schematic faces used is the colour naming trials, probe classification trials, SOA setting trials and the final awareness check trials in Study 2.1, 2.2, 3.1 and 3.2.

Three scrambled faces (non-faces) were developed and used in the SOA setting trials and the final awareness check trials and are shown in Figure 3.2. Each scrambled face consisted of randomly re-positioned features of the happy, neutral and threat faces. In creating these scrambled faces, the same head outline and ear placement were used as with the faces. The scrambled faces differed in the placement of features within the face outline. Specifically, the mouth was placed in the area formerly occupied by the eyebrows, the eyebrows in the area formerly occupied by the eyes, the eyes in the area formerly occupied by the nose and the nose in the area formerly occupied by the mouth.

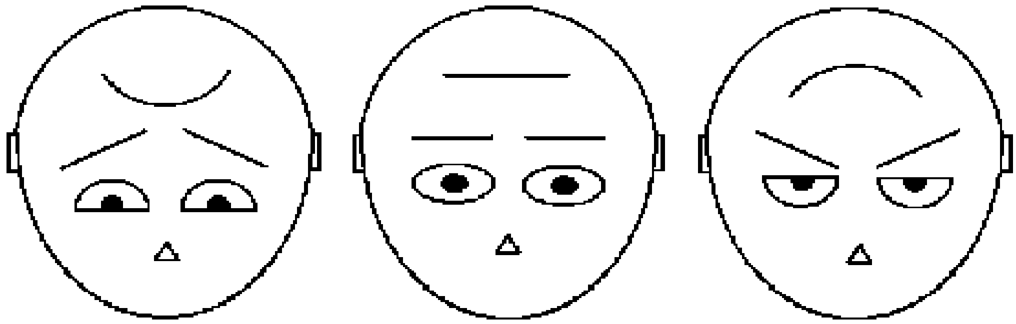

Figure 3.2. Three scrambled faces used in the SOA setting trials and in the final awareness check trials in Study 2.1, 2.2, 3.1 and 3.2

Four masks were developed to use in the SOA threshold setting trials, colour naming trials and final awareness check trials, and are shown below in Figure 3.3. The masks used a proportionate number of features from each face valence (happy, neutral & threat). The masks used the same outline of the face and the same ear position as with the faces and non-faces. To reduce the likelihood of the subliminal content from penetrating through the mask, complex arrangements of features were developed. Specifically, each mask contained three eyebrows, five eyes, three noses and three mouths, which were randomly positioned within the head.

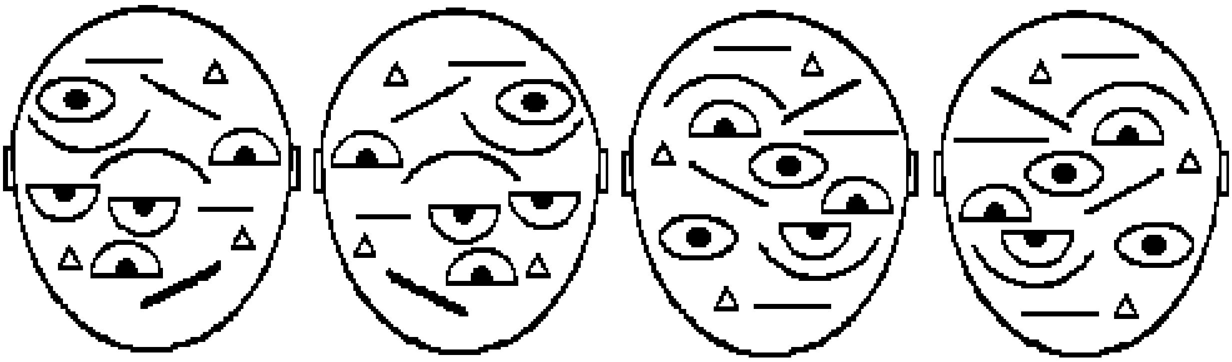

Figure 3.3. Four masks used in the SOA setting trials, colour naming trials, probe classification trials and final awareness check trials to prevent awareness of subliminal stimuli.

Each stimulus face, non-face and mask was presented in red, green, blue or yellow placed against a grey background in Study 2.1 and 2.1. In Study 3.1 and 3.2 face, non-face and mask stimuli were presented in black colouring against a grey background. All faces were matched on size, line thickness and colour and were placed in the centre of the grey screen. The details of stimulus counterbalancing are described in the relevant chapters.

Psychometric Measures

Beck Depression Inventory

The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961) is a 21 item self-report measure designed to assess severity of depression symptoms in adolescence and adults across clinical and non-clinical populations. These items assess current (state), affective, somatic, behavioural and cognitive components of depression. Specifically, these items assess attitudes about mood, pessimism, sense of failure, lack of satisfaction, guilt feelings, sense of punishment, self-dislike, self-accusations, suicidal wishes, crying, irritability, social withdrawal, indecisiveness, distortion of body image, work inhibition, sleep disturbance, fatigability, loss of appetite, weight loss, somatic preoccupations and loss of libido (Beck, Ward, Mandelson Mock & Erbaugh, 1961; Beck & Steer,1984). The BDI is also useful in discriminating the symptoms of depression from those of clinical and non-clinical anxiety (Weeks & Heinberg, 2005). This measure was included to control for the comorbidity of depression, because depression and anxiety often co-occur (Hirschfeld, 2001**).** The BDI is attached as Appendix A.

Reliability and validity. The BDI is reliable and valid for assessing the severity of depressive symptomology in both clinical and non-clinically anxious populations (Beck et al., 1961; Blumberry, Oliver & McClure, 1978). This instrument possesses high internal consistency (Cronbach’s alpha = 0.93; Beck et al., 1961).

Scoring and inclusion criteria. Participants respond to the items by choosing the response that best described how they were feeling that day, including right at that moment, as an index of their current (state) depressive symptomology. Each item contains 4, 5 or 6 statements ranging in severity from 0 to 3, where each statement is assigned a numerical value of 0 (e.g., I don’t cry any more than usual), 1 (e.g., I cry more now than I used to), 2 (e.g., I cry all the time now. I can’t stop it), or 3 (I used to be able to cry, but I can’t cry at all even though I want to). On some items two or three alternative statements are presented and labelled “a”, “b” or “c” following the numerical value (e.g., 3a, 3b, 3c) which signifies that they are on the same level and thus given the same weight. (Beck et al., 1961). The depression severity index range from 0 to 63 and is calculated by summing up all numerical responses for all 21 items, with higher scores reflecting higher levels of self-reported depression. Scores of 0-9 reflect “minimal” depression, 10-19 “mild” depression, 17-29 “moderate” depression and 30-63 reflect “severe” depression (Beck et al., 1961; Bumberry et al., 1978). Given that the BDI was only employed in Study 1 with clinically anxious participants, the inclusion criteria allowed for elevated levels of depression to be included as a covariate in the final RT data analysis. The BDI was chosen for use in Study 1 because it was a consistent measure used across other studies employing the emotional Stroop task with verbal stimuli (e.g., Edwards, Burt & Lipp, 2006).

Depression Anxiety and Stress Scale

The Depression Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995) is a 42 item self-report scale, divided into three 14 item subscales used to measure and discriminate between depression, anxiety and stress. The items on the depression scale assess low mood, motivation and self-esteem (Lovibond & Lovibond, 1995; Parkitny & McAuley 2010), such as: dysphoria, hopelessness, devaluation of life, self-depreciation, and lack of interest/involvement, anhedonia and inertia. Example items include “I couldn’t seem to experience any positive feeling at all” and “I found it difficult to work up the initiative to do things”. The items on the Anxiety scale assess physiological arousal, perceived panic and fear (Lovibond & Lovibond, 1995; Parkitny & McAuley 2010), such as, autonomic arousal, skeletal musculature effects, situational anxiety and subjective experience of anxiety. Example items include “I was aware of dryness of my mouth” and “I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)”. The final items make up the Stress scale and assess tension and irritability (see Parkitny & McAuley, 2010), such as difficulty relaxing, nervous arousal, easily upset/agitated, irritable/over-reactive and impatient. Example items include “I found it hard to wind down” and “I tend to over react to situations”. The DASS is designed to assess state rather than trait characteristics by asking participants to indicate how much each item applied to them over the past week. To reduce the 45-50 minute testing time and to control for possible fatigue effects the 21-Item version of the DASS was employed. The DASS is attached as Appendix B.

Reliability and validity. The DASS is a reliable and valid measure for detecting levels of depression, anxiety and stress in clinical and non-clinical populations (Lovibond & Lovibond, 1995). In a sample of 124 in-patients diagnosed with primary depression, Page, Hooke and Morrison (2007) found the DASS to possess high internal consistency for the total scale (Cronbach's α = .97), individual scales (Depression = .96; Anxiety = .92 and; Stress = .95) and between scales (Depression-Anxiety = 0.66; Anxiety-Stress = 0.75 and; Depression-Stress = 0.74). The DASS is effective in discriminating normal from clinical populations with concurrent validity coefficients of .87 and .84, respectively (Atkin & Çetin, 2007). Cronbach's internal consistency was reported by Atkin and Çetin, (2007), at .89 for the entire scale and item-total correlations ranged from .51 to .75. The test- retest reliability coefficients were reported at .99 and split-half reliability coefficients at .96 (Atkin & Çetin, 2007). It was considered that this is a valid and reliable measure for the intended purpose. The reliability and validity of the DASS extend to the DASS-21 which is deemed to be internally consistent with Cronbach's α = .94 for Depression, .87 for Anxiety and .91 for Stress (Anthony, Bieling, Cox, Enns & Swinson, 1998).

Scoring and inclusion criteria. Participants indicated on a 4 point scale the degree to which the 21 items applied to them over the past week. Of the 21 items of the DASS-21, seven made up the Depression scale, seven the Anxiety scale and seven items made up the Stress scale. The anchors for the responses on each scale are: (0) did not apply to me at all; (1) applied to me to some degree, or some of the time; (2) applied to me a considerable degree, or a good part of time; and (3) applied to me very much, or most of the time. The possible range of scores on the seven items of each scale was 0-21, with higher scores representing increased severity of depression, anxiety and stress (Lovibond & Lovibond, 1995; Parkitny & McAulley, 2010). On the DASS – 21 the severity index for each scale is calculated by summing the 4 point scale responses for all seven items on each scale and multiplying the sum by two. On the Depression scale scores of 0-9 represent "Normal" depression, 10-13 "Mild" depression, 14-20 "Moderate" depression, 21-27 "Severe" depression and 28+ "Extremely Severe" depression. On the Anxiety scale scores of 0-7 represent "Normal" anxiety, 8-9 "Mild" anxiety, 10-14 "Moderate" anxiety, 15-19 "Severe" anxiety and 20+ "Extremely Severe" anxiety. On the Stress scale scores of 0-14 represent "Normal" Stress, 15-18 "Mild" stress, 19-25 "Moderate" stress, 26-33 "Severe" stress and 34+ "Extremely Severe" stress. To calculate the total score for each scale on the DASS 21, the total scores of each scale are multiplied by two. For ethical considerations, participants who scored above 27 (Extremely Severe range) on the Depression scale were excluded from the study (see 'participant' in corresponding studies for exclusion rates). The DASS-21 is attached as Appendix C. Scores from the depression scale only were included as covariates in the studies 2.1, 2.2, 3.1 and 3.2.

State-Trait Anxiety Inventory – Form Y

The State-Trait Anxiety Inventory – Form Y (STAI; Speilberger, Gorsuch, Lushene, Vagg & Jacobs, 1983) is a 40 item self-report measure of anxiety. The measure is comprised of two 20-item self-report scales designed to measure state and trait anxiety symptoms. The 20 items (items 1-20) on the STAI- S-Anxiety Scale (STAI Form Y-1) are designed to measure how participants feel '*right now* at this moment'. This scale assesses feelings of apprehension, tension, nervousness and worry. This scale is also useful in gauging the anticipated responses of participants in future situations or in hypothetical situations (Speilberger et al., 1983). The 20 items (items 21-40) on the STAI-T Anxiety Scale (STAI

Form Y-2) are a measure of how participants '*generally*' feel. This scale is used for identifying high levels of neurotic anxiety in clinical settings and when selecting participants for psychological experiments (Speilberger et al., 1983). The STAI-Form Y was revised from an earlier scale (STAI-Form X; Speilberger, Gorsuch, & Lushene, 1970) to better discriminate between symptoms of anxiety from symptoms of depression (Speilberger et al., 1983).

Reliability and validity. The STAI is verified as being an appropriate measure for differentiating between state and trait anxiety in non-clinical samples (Spielberger et al., 1983). In a sample of 855 college students and 1838 working adults, the instrument is reported to have high internal consistency with alpha coefficients greater than .90 across gender (male and female) and age groups (19-39 years, 40-49 years and 50-69 years) of college students and working adults on the Y-1 and Y-2 forms. According to the authors, due to the transient nature of state anxiety, on Form Y1 the test-retest reliability in college students at a 104 day interval was much lower (male, $r = .33$, female, $r = .31$) than the test-retest coefficients on Form Y2 (male, $r = .73$, female, $r = .77$).

Speilberger et al (1983) demonstrated evidence of construct validity for Form Y with significantly higher mean scores on Form Y2 for psychiatric patients with anxiety disorders compared to a sample of age and sex matched controls. Construct validity was further established by reports of higher Y1 scores in military recruits shortly after commencing a stressful training program compared to a sample of age and sex matched controls who were not exposed to highly stressful conditions. Similarly, in a group of college students Y1 scores were significantly higher during examinations and significantly lower after relaxation training compared to scores during regular class time times.

Scoring and inclusion criteria. As recommended by Speilberger et al. (1983) participants completed Form Y-1 (STAI-S) prior to completing Form Y-2 (STAI-T). Participants were asked to respond to each statement using a four point Likert scale. A response of 1-4 was chosen depending on the degree to which each statement applied to them. On Form Y-1 (STAI-S) the anchors for the 20 items are: (1) not at all; (2) almost never; (3) very much so; and (4) almost always. Items 2, 3, 5, 8, 10, 11, 15, 16, 19 and 20 on this scale are reversed score. Example items are “I feel tense” and “I feel nervous”. On Form Y-2 (STAI-T) the anchors for the 20 items are: (1) almost never; (2) sometimes; (3) often; and (4) almost always. The reverse scored items for this scale are 21, 23, 26, 27, 30, 33, 34, 36 and 39. Example items are “I feel nervous and restless” and “I feel insecure”. The final scores on each scale were calculated by summing the responses to all 20 items. The scoring index for each scale (Form Y-1 and Form Y-2) ranges from 20-80 with higher scores reflecting higher levels of State (Form Y-1) and Trait (Form Y-2) anxiety.

Cut off scores for STAI Form Y-2 (STAI-T) were determined based on the normative data reported by Speilberger et al. (1983) and for ease of comparisons across previous literature (e.g., Edwards, Burt & Lipp, 2006, 2010a, 2010b; McLeod & Rutherford, 1992; Miller & Patrick, 2000). In the non-clinical sample of participants across the current set of studies, those who scored 36 or below on Form Y-2 (STAI-T) were assigned to the low trait anxious (LTA) group and those who scored 37 or above were assigned to the high trait anxious (HTA) group. To comply with the university ethics committee, any participant who scored above 65 on either scale of this measure was excluded from participating. This decision was made for ethical reasons to reduce the possibility of highly anxious individuals being further exposed to anxiety inducing stimuli, such as electric shock, threatening faces and threatening words. The STAI Form Y-1 (STAI-S) is attached as Appendix C1 and the STAI Form Y-2 (STAI-T) is attached as Appendix C2

Marlowe – Crowne Social Desirability Scale - Form XI

The original Marlow-Crowne Social Desirability Scale (MCSDS; Crown & Marlowe, 1960) is a 33 item self-report measure assessing impression management with a True – False response format (Loo & Thorpe, 2000). The items represent infrequently enacted behaviours that are perceived as exemplary in society and assess the extent to which individuals present themselves in a positive and socially desirable way in terms of temperament, demeanour and personality in an attempt to please (Crowne & Marlowe, 1960). To reduce the 45-50 minute testing time and to control for possible fatigue effects the short form (Form XI) of the Marlow-Crowne Social Desirability Scale (MCSDS – Form XI; Strahan & Gerbasi, 1972) was used in the current series of experiments. The short form contains 10 of the original 33 true and false items. These items are seen to tap defensiveness, protection of self-esteem and affect inhibition (Eysenck, 1992).

Reliability and validity. This MCSDS-Form XI is internally consistent (Cronbach's $\alpha = .88$; Fischer & Fick, 1993), generalizable (Strahan & Gerbasi, 1972), and stable across socioeconomic status and sex (Barger, 2002; Fraboni & Cooper, 1989). Given that the Short Form XI is highly correlated with the original MCSDS ($r = .96$; Fischer & Fick, 1993; Strahan & Gerbasi, 1972) and the original possesses strong test-retest reliability ($r = .89$; Crowne & Marlowe, 1960), it was established that this would be a valid and reliable measure of social desirability for the current purpose. The MCSDS Form XI is included as Appendix D.

Scoring and inclusion criteria. Participants were encouraged to carefully read each statement and answer as honestly as possible. Using a True/False response format, participants were instructed to indicate whether the 10 statements applied to them (True) or did not apply to them (False). To control for potential response bias, the measure contained positive and negative scored items. "True" responses on the first 5 items (e.g., I am always willing to admit it when I make a mistake, I always try to practice what I preach) and "False" responses on the last five items (e.g., I like to gossip at times, there have been occasions when I took advantage of someone) suggest socially desirable responding. On this measure, lower scores reflect higher social desirability. To date no general cut off ranges have been reported. Previous studies have employed cut off ranges of five or fewer socially desirable responses (Edwards, Burt & Lipp, 2010a). In the current series of studies, participants were only retained if they answered six or fewer of 10 socially desirable responses. Honest (non-socially desirable) response scores were used in the final analysis.

The Arousal Rating Questionnaire (ARQ)

The ARQ is a short self-report scale adapted from Edwards et al. (2006) and was used to assess changes in participants' state anxiety levels during the course of the experiment. The dimensions representing state anxiety were nervousness, fearfulness and anxiousness. This instrument was preferred over the conventional 20 item STAI-S (Form Y-1) because it is a shorter alternative and less time consuming.

Reliability and validity. The ARQ has been reported as a valid measure of state anxiety (Edwards et al., 2006). In constructing the ARQ as a measure of state anxiety, Edwards et al. considered only those items that loaded more than .50 for both females and males on Factor 1 (State Anxiety Present Symptoms) on the STAI Form Y1. Four items were found to meet these criteria. Of those 4 items, two items (item 18- I feel confused, and item

13- I feel jittery) were removed because they were deemed not to be appropriate for assessing changes in state anxiety across relatively short intervals. Item 9 (I feel frightened) with a loading of .50 for females and .57 for males, and item 12 (I feel nervous) with a loading of .69 for females and .60 for males on the State Anxiety Present Symptoms were included as anchors on the measure along with an additional dimension of a anxiousness which was appropriate for tapping the construct of state anxiety. Further validation procedures confirmed significantly positive correlations between scores on the three dimensions of the ARQ and the STAI-S Form Y1: nervousness $r(31) = .47$, fearfulness $r\ (31) = .49$ and anxiousness $r\ (31) = .40$, all $p < .05$. Thus, the three dimensions of the ARQ, nervousness, fearfulness and anxiousness, were deemed a valid measure of state anxiety. The measure was also shown to be sensitive in detecting changes in state anxiety levels in line with the experimental manipulation of that factor in the current thesis (i.e., threat of shock).

Scoring. Participants were instructed to report how they felt "*right now at this moment*" on the dimensions of fearfulness, nervousness and anxiety. Responses were collected on four occasions during the experimental session (once before every block of trials). Three bipolar states made up the scale: (1) nervous – calm; (2) fearful – fearless and; (3) anxious – relaxed. The seven bipolar scale ranges were 3-2-1-0-1-2-3 with the anchors representing (3) very (2) quite (1) slightly or (0) neither/nor. Specifically, the anchors for the bipolar states of nervousness to calm were: (3) very nervous or very calm, (2) quite nervous or quite calm, (1) slightly nervous or slightly calm and (0) neither nervous nor calm; for fearfulness to fearless: (3) very fearful or very fearless, (2) quite fearful or quite fearless, (1) slightly fearful or slightly fearless and (0) neither fearful nor fearless; and for anxious to relaxed: (3) very anxious or very relaxed (2), quite anxious or quite relaxed, (1) slightly anxious or slightly relaxed and (0) neither anxious nor relaxed. Negative values were assigned to the nervousness, fearfulness and anxiousness dimensions while positive scores were assigned to calmness, fearless and relaxed. The mean scores for each dimension across the four ARQs were calculated. Negative scores reflected more nervousness, fearfulness and anxiousness, while positive scores reflected the opposite. The Arousal Rating Questionnaire is attached as Appendix E

Data Cleaning & Analysis

Data Reduction

The reaction time data were reduced in four stages prior to statistical analyses. First, data consisting of microphone failures were removed to ensure that data used in the statistical analyses represented actual responses to the tasks. Second, any data that was not an accurate response to the colour of the stimulus or probe (e.g., stuttering or reporting the wrong probe or colour) was coded as errors and removed from statistical analysis. The error data was analysed separately to investigate speed vs. accuracy trade-offs. Third, responses less than 300 msec or more than 3000 msec on the experimental trials. Fourth, data more than 2 standard deviations from each individual cell mean were deemed as outliers and were removed from the statistical analyses.

Statistical Analyses

IBM SPSS Statistics 21 was used for all statistical analyses. Omnibus tests were computed using SPSS GLM REPEATED MEASURES. Univariate *F* ratios are reported. As an index of the relative magnitude of mean differences, the univariate partial eta squared statistics are reported. All tests for statistical significance were considered significant at α = .05. Follow up analyses were made using *t* tests and post-hoc comparisons were carried out with Bonferroni adjustment to control for the inflation of family wise error rates. The sample size was determined on the basis of previous studies, for counterbalancing purposes and power of 0.8.

Chapter 4

Automaticity of Attentional Biases for Verbal Threat in Anxiety

The purpose of this chapter is to examine a number of central assumptions proposed by the theoretical models described in Chapter 1 (Clark & Beck, 2010; Mogg & Bradley, 1998; Öhman and Mineka, 2001). The models propose that anxiety is characterized by an attentional bias for threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. In addition, this chapter will further investigate the hypothesis proposed by Öhman (1993) who places emphasis on priming of threat during conscious processes to elicit selective attention at preattentive levels. The emotional Stroop colour naming task was used for the purpose of this investigation because it was considered to be the most appropriate paradigm in comparison to others (e.g., dot probe task) particularly for the investigating the automaticity of selective attention to threat in anxiety (see Chapter 2 for a review).

Attention to Verbal Threat without Awareness

In support of the theoretical models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) there have been a number of accounts of selective attention for both masked and unmasked verbal threat in both clinically anxious and non-clinical HTA and LTA individuals on the emotional Stroop and dot probe tasks. However, after accounting for a number of procedural limitations associated with those studies, others have found accounts of selective processing of unmasked verbal threat, but masked threat processing was only evident when masked and unmasked trials have been presented intermixed or when participants were exposed to unmasked verbal threat first. The latter accounts provide support for Öhman's (1993) priming hypothesis. However, these accounts are limited to non-clinical samples of HTA and LTA participants. To date, no known studies have employed procedures capable of controlling for potential priming effects when investigating the role of awareness in selective processing of verbal threat at preattentive levels in clinically anxious individuals. Each of these accounts is summarized below. Perhaps if clinically anxious participants, relative to non-clinical HTA participants show preconscious threat bias in the absence of priming then this might represent a marker of clinically significant anxiety.

In attempting to assess for the “without awareness’’ component of the automaticity hypothesis on selective processing of verbal threat in clinical and non-clinical anxiety, most studies employing the dot probe or emotional Stroop methodology have employed intermixed presentations of masked and unmasked word stimuli. For example, selective processing of masked threat words was noted with clinically anxious groups (e.g., Bradley, Mogg, Millar & White, 1995; Harvey, Bryant & Rapee, 1996; Mogg, Bradley & Williams, 1995; Mogg, Bradley, Williams & Mathews, 1993) and non-clinical groups (e.g., Edwards, Burt & Lipp, 2006, 2010a; Macleod & Rutherford, 1992; Rutherford, MacLeod & Campbell, 2004). Despite the compelling data demonstrating selective attention for masked threat words in anxiety, it is unknown whether conscious awareness of threat on unmasked trials may have primed the mechanisms responsible for eliciting selective processing of threat at preattentive levels because the aforementioned studies presented masked and unmasked trials intermixed.

In questioning the extent to which selective processing of threat operates outside of conscious awareness, in line with Öhman (1993), Fox (1996) suggested that post-conscious awareness of threat may affect responses on masked trials. Fox (1996) employed three experiments with HTA and LTA participants to assess the priming hypothesis. In Experiment 1, participants were presented with masked and unmasked trials intermixed; in Experiment 2, a block of masked trials was presented first, followed by a block of unmasked trials; and in

Experiment 3, Fox blocked on exposure such that half the participants were presented with a block of masked trials first, followed by a block of unmasked trials, whereas the other half received the reverse order. The results indicated that when masked and unmasked trials were intermixed, HTA participants demonstrated an attentional bias for masked threat words relative to control words. When masked trials were presented before the unmasked trials there were no differences in masked threat processing. However, when unmasked trials preceded the masked trials, HTA participants demonstrated an attentional bias for masked threat relative to control words. These data indicate that preattentive threat processing may rely on post-conscious priming effects.

In attempting to further investigate the role of awareness in selective processing of threat in anxiety, Edwards, Burt and Lipp (2010b) questioned the effectiveness of the state anxiety manipulation employed by Fox (1996). Fox manipulated state anxiety via a past stressor in Experiment 1 and a future stressor in Experiment 2, whereas no state anxiety manipulation was mentioned for Experiment 3. Given that elevations in state anxiety have been critical in producing masked threat processing effects (see Chapter 2; Edwards et al., 2006; MacLeod & Rutherford, 1992; Rutherford et al., 2004), Edwards et al. (2010b) employed the emotional Stroop colour naming task by blocking on exposure presentation and included a state anxiety manipulation that reflected a current stressor (threat of electric shock). The results revealed that, when masked trials were presented first and irrespective of shock condition, there were no differences in processing masked or unmasked threat words in either HTA or LTA groups. However, when unmasked trials were presented first, HTA relative to the LTA participants were slower to colour-name masked and unmasked threat words relative to neutral words. These findings were in line with Fox (1996; Experiment 3). However, Fox (1996) and Edwards et al. (2010b) restricted their investigation into the role of awareness on threat processing to non-clinical samples of HTA and LTA anxious participants. Therefore, their findings do not provide information into the threat processing behaviours of clinically anxious individuals.

Study 1

Selective Attention for Verbal Threat Blocked on Exposure Mode in the Clinical and Non-Clinical HTA and LTA Participants on the Emotional Stroop Colour Naming Task

Aim of Study

The aim of the present study was to investigate whether priming of threat is a necessary precondition to elicit preconscious threat biases in clinical vs. non-clinical participants. The study further aimed to assess a number of central assumptions of the models described in Chapter 1 (Clark & Beck, 2010; Mogg & Bradley, 1998); Öhman & Mineka, (2001). The models propose that anxiety is characterized by an attentional bias to threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. First, to investigate selective processing of threat in anxiety, threat related and non-threat related words were employed with a sample of clinically anxious and non-clinical HTA and LTA participants. To investigate the 'involuntary' component of the automaticity hypothesis, the current study employed an interference paradigm (emotional Strop colour naming task). To investigate the 'without awareness' component of the automaticity hypothesis, the current study presented verbal stimuli within (unmasked) and outside (masked) of conscious awareness. To investigate the role of priming in moderating selective processing of masked threat, the current study blocked on exposure mode presentation order, such that half the participants within each anxiety group received masked trials followed by unmasked trials whereas the remaining half of the participants received the opposite order.

The study further aimed to investigate the relative influence of state and trait anxiety in moderating threat processing biases. To achieve this, non-clinically anxious participants were allocated to a trait anxiety group (HTA vs. LTA) based on questionnaire scores and half of the participants within each trait anxiety group performed under the threat of shock, whereas the remaining half performed under shock safe conditions.

Hypotheses

In considering all theoretical models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) several specific predictions were made. First, if priming is not needed to elicit preconscious threat processing effects, then in line with Clark and Beck and Mogg and Bradley it was predicted that the clinically anxious and HTA relative to LTA participants would be slower to colour name masked and unmasked threat words relative to neutral words irrespective of whether masked or unmasked trials were presented first, but only while performing under the threat of shock (HTA only). However, if priming is needed to elicit masked threat processing effects, then in line with Öhman (1993) it was predicted that HTA relative to LTA participants would be slower to colour name masked threat words relative to neutral words but only when performing under the threat of shock and only when unmasked trials were presented before the masked trials. Alternatively, if selective processing of masked threat is a marker of clinical anxiety, then relative to non-clinical participants, clinically anxious participants would be slower to colour name masked threat words relative to neutral words irrespective of whether masked trials or unmasked trials were presented first.

Method

Participants

A sample of 201 participants was recruited for the study. Of those, 32 were clinically anxious volunteers recruited from various agencies on the Gold Coast, and 196 made up the non-clinical sample that included Bond University students, staff and Gold Coast community volunteers. Chapter 3 details incentives to participate and initial screening criteria. Of those who met the initial screening criteria, four non-clinical participants were excluded due to high depression scores and 14 due to high social desirability scores. They were thanked, given their incentive and a handout detailing the nature of the study, then released. Of those included in the experimental phase, data from a further two participants was excluded. One participant did not disclose a cardiac condition and another did not disclose that English was not her first language during the initial screening stage. A further five participants were excluded due to equipment failure, and data from a further 16 participants were excluded on the basis of their performance on the final awareness check trials. The final sample consisted of 160 participants, 32 males and 128 females, aged 18 years to 65 years (M = 24.14 years; SD = 7.66).

The clinically anxious participants made up the clinical sample (n = 32) and the non-clinical participants were allocated to a HTA group (shock safe, n = 32; shock threat, n = 32) and an LTA group (shock safe, n = 32; shock threat, n = 32) on the basis of scores on the STAI-T. In line with MacLeod and Rutherford (1992), and Edwards et al. (2006), participants who scored 36 and below on the STAI-T were assigned to the LTA group and those who scored 37 and above were assigned to the HTA group. Based on their order of arrival to the laboratory, half of the non-clinical participants within each trait anxiety group were then randomly allocated to shock condition group, which resulted in 64 participants assigned to the shock safe group and 64 to the shock threat group. On the basis of these procedures, five anxiety groups (Clinical, *n* = 32; LTA, shock safe, *n* = 32; LTA, shock threat, *n* = 32; HTA, shock safe, *n* = 32; and HTA, shock threat, *n* = 32) were included in this study. Half of the participants within each anxiety group completed two blocks of masked trials first followed by two blocks of unmasked trials, whereas the other half of the participants completed the opposite order.

Apparatus

Details for the Experimental Hardware, Software and Electric stimulus used in Study 1 are described in Chapter 3 above.

Materials

Word stimuli. Details on the word and non-word stimuli used in the initial threshold setting trials, practice trials, colour naming trials and final awareness check trials in Study 1 are described in Chapter 3 above.

Psychometric Measures

All Participants completed the STAI, BDI, MCSDS and ARQ. Chapter 3 provides a detailed description of each questionnaire including psychometric properties, scoring and inclusion/exclusion criteria.

Design

A 5 X 2 X 2 X 2 mixed design was used for the study. The within subjects factors were valence (threat words vs. neutral words) and exposure mode (masked vs. unmasked). The between subjects factors were anxiety group (clinical; LTA, shock safe; LTA, shock threat; HTA, shock safe; HTA, shock threat) and presentation order (unmasked first vs.

masked first). The dependent variables were colour naming reaction times and colour naming errors.

Procedure

After providing informed consent, answering eligibility questions, completing questionnaires and following the allocation to conditions, all groups underwent the stimulus onset asynchrony (SOA) threshold setting and shock intensity setting procedure followed by practice trials, experimental trials and final awareness check trials.

SOA threshold setting. Each participant was presented with a series of word and non-word decision trials in which either a word in English or a non-word was briefly presented on the screen and quickly replaced by a pattern mask. To ensure that the exposure thresholds were conservative, each word was presented in lower case letters ranging between 4 and 11 characters in length while each non-word was presented as a random string of upper case letters also ranging in length from 4 to 11 characters. Each pattern mask consisted of a random string of 11 upper case letters. Each block consisted of 10 trials with five words and five non-words randomly presented. Participants were instructed to indicate whether a non-word preceded the onset of the mask by pressing a clearly labelled left arrow on their keyboard for word and the right arrow for non-word. If participants were unsure of the stimulus status they were instructed to guess. A potential for a response bias was controlled by reminding participants who reported seeing all words or all non-words of the experimental parameters. To ensure participants could discriminate between the items, participants were made familiar with the word / non-word exemplars via a printout prior to this task.

On each trial, participants were presented with a row of three white crosses in the centre of the screen for 1 second. These crosses served as a fixation point for the stimuli, and as a warning that the trial was about to commence. At the offset of the crosses, the screen was then blanked for 250 msec and replaced by either a red, green, blue or yellow word or non-word in the location formerly occupied by the crosses. A mask of the same colour replaced the word or non-word. In the first block of trials the SOA between the word/non-word and the mask started at 80 msec and was systematically shortened to 60, 40, 30, 25, 20, 15, 10, and 5 msec if an accuracy score of 5 or more of 10 was achieved. Participants were provided performance feedback at the end of each block. On a given block where fewer than 5 correct responses were achieved, participants were presented with a block of 20 trials with the same SOA to ensure that they remained unaware of the stimulus content. Participants were informed that in a block of 20 trials, 10 trials would present words and 10 would present non-words. On a block of 20 trials, when fewer than 10 correct responses were achieved the SOA was used as the participant's subjective level of non-awareness and was applied to the practice and experimental blocks. If 10 or more correct responses were achieved, the SOA was reduced to the next level and a block of 10 trials was presented. This procedure was adapted from Dagenbach, Carr and Wilhelmsen (1989).

Shock intensity setting. After the SOA setting procedure participants who were assigned to the shock threat group underwent a procedure to set the shock intensity. All participants were made aware that the shock intensity set during this procedure would remain fixed for the duration of the experiment. Using a velcro strap, the electrode was attached to the volar surface of the participant's left arm. A 200 msec electric shock was administered to the participant, starting at a base line of 0 volts. The shock intensity was increased in increments of 10 volts on each presentation to a maximum of 90 volts, until the participant indicated that the shock was "uncomfortable but not painful". Once the shock intensity had been set, the electrode was removed and participants were informed that the electrode would be re-attached at a later stage in the experiment.

Practice trials. Prior to starting the practice block, all participants received standard instructions. They were asked to name the colour of the stimuli as quickly and accurately as possible while ignoring the semantic content of the items. All participants completed a block of 40 practice trials to familiarize themselves with the experimental task. On each trial, participants were presented with a row of three white crosses in the centre of the screen for one second. The crosses served as a fixation point for the stimuli. The screen was than blanked for 250 msec and replaced by either a red, green blue or yellow English word or then pattern mask in the location previously occupied by the three crosses. Half of the trials were unmasked and half were masked. On the unmasked trials, the word remained on the screen until the participant's first vocal response was recorded by the experimental software. On the masked trials, the word was presented for the duration determined during the SOA threshold setting procedure and at the offset was replaced by a mask of the same colour. The mask remained on the screen until the participant's first vocal response was recorded, at which time the screen was blanked. The experimenter recorded the participant's response on a separate computer. Any initial responses that clearly indicated the colour of the stimulus were coded as "correct" or they were coded as "incorrect" if the initial response was not a clear identification of the colour of the stimulus (e.g., if the participant stuttered, said the wrong colour or named the word). Any response that failed to be recorded by the experimental software was coded as a microphone failure. After the experimenter coded the responses the next trial was initiated, with an average of a two second inter-trial interval.

All participants were presented with 20 masked and 20 unmasked practice trials. The presentation of masked and unmasked stimuli was randomised but governed by the following restrictions: the same exposure mode was never presented on more than four consecutive trials; each colour (red, green, blue and yellow) was presented an equal number of times in masked and unmasked exposure modes; each colour was presented in each exposure mode five times; and the same colour did not appear on more than three consecutive trials in the block.

All participants received a three minute rest period at the completion of the practice block. Those in the shock threat group had the electrode re-attached, and were informed that the computer would deliver between five and seven electric shocks at random across the remaining four blocks of experimental colour naming trials. In reality, the experimenter delivered the electric shocks, and only five were administered for the remainder of the experiment. Shocks were delivered to maximize unpredictability and to control for possible habituation to the electric stimulus. The first electric shock was administered 15 seconds prior the first experimental colour naming trial. This was done to ensure that participants believed the instructions given to them. The timing of the remaining four electric shocks is described below. All participants were informed that the delivery of the shocks was independent of their performance on the colour naming trials.

Colour naming trials. Four blocks of 40 colour naming trials were administered. Participants who were assigned to the unmasked first condition received two blocks of 40 unmasked trials first followed by two blocks of 40 masked trials. The masked first group received the opposite presentation order. On the unmasked trials the threat and neutral words were presented in the colours red, green, blue or yellow and remained on the screen until the participant's first vocal response. On the masked trials, the word was presented and remained on the screen for the SOA duration previously set in the SOA threshold setting trials, after which the stimulus was replaced by a mask of the same colour.

For counterbalancing reasons, the threat related and control words were divided into two 80 words lists (A and B), and each list contained 40 threat related words and 40 control words matched for average length and frequency (see Chapter 3, Table 3.1). Word lists were counterbalanced across presentation order (masked first vs. unmasked first), exposure mode (masked vs. unmasked), and anxiety group (clinical, HTA shock threat, HTA shock safe, LTA shock threat, LTA shock safe). That is, within each of the five anxiety groups, half of the participants received two blocks of unmasked trials first followed by two blocks of masked trials, whereas the other half received the opposite order. Further, half of the participants received Set A words unmasked, and Set B words masked (see Chapter 3 for details) whereas the other half received the opposite order. The randomization of stimuli was governed by the following parameters. First, 20 threat and 20 length and frequency matched control words were presented in a block of 40 trials. The same word type was never presented on more than four consecutive trials and each participant was presented with each of the 160 stimuli once across the four blocks of 40 trials. Each colour (red, green, blue and yellow) was assigned to each word valence five times and appeared 10 times in a block of 40 trials. The same colour was never presented on more than two consecutive trials within the block.

Prior to the first block of experimental colour naming trials, participants completed the ARQ for the first time. A brief rest period followed before the colour naming trials commenced and 15 seconds prior to the initiation of the first trial in Block 1 those in the shock threat group received their first shock. On each experimental colour naming trial, participants were presented with a row of three white crosses in the centre of the screen for one second. The screen was then blanked for 250 msec and replaced by either a neutral or threat word in either red, green blue or yellow colouring, in the location formerly occupied by the crosses. The item remained on the screen until the first vocal response was recorded by the experimental software in unmasked trials. On the masked trials, a mask of the same colour replaced the word at the same SOA as previously determined during the initial threshold setting phase, and remained on the screen until the software recorded the first vocal response. Participants in the shock threat group received a second shock immediately following their final colour naming response in the first block. All participants completed the second ARQ during the rest time between Block 1 and Block 2 and those in the shock threat group received their third shock at this time. Block 2 commenced once participants completed the questionnaire. During the rest period between Block 2 and Block 3 participants filled out the third ARQ; 15 seconds prior to commencing Block 3 those in the shock threat group received their fourth electric shock. The fifth and final eclectic shock was administered immediately following the participant's vocal response for the final trial in Block 3. At this stage participants were anticipating up to two more shocks until the competition of the experimental trials. Participants completed the final ARQ at this time, after which the final block of trials was initiated. Once the final block was completed, those in the shock threat group had the electrode removed.

Awareness check trials. Following the completion of the four blocks of experimental colour naming trials, each participant completed a block of 40 word/non-word awareness check trials to ensure that they remained unaware of the masked stimuli throughout the experiment. The parameters of this procedure were identical to those employed in the SOA threshold setting trials. Participant data was included in the final analysis only if they achieved a score of 24 or fewer correct responses on this task. The data for those who scored 25 or more correct responses was not included in the final analysis. All participants were thanked, debriefed and released following the final awareness check trials.

Results

Manipulation Checks

Three manipulation checks were conducted to determine whether the anxiety groups were differentiated on STAI-T scores and the experimental manipulations prior to statistical analysis of the colour naming reaction time data. First, the validity of anxiety group status was analysed to ensure that the clinically anxious and non-clinical HTA and LTA participants significantly differed on self-reported trait anxiety, to assess for group differences in self-reported state anxiety and depression and age and gender distribution among the groups. The validity of state anxiety manipulation was also assessed to ensure that for the non-clinical participants, the threat of shock was an effective manipulation of state anxiety, as operationalized by responses on the ARQ. Third, the validity of the masking procedure was assessed to ensure that participants remained unaware of the content on the masked trials. Table 4.1 presents means and standard deviations for questionnaire and age variables.

Validity of anxiety group status. To verify that the clinically anxious and non-clinical HTA and LTA participants significantly differed on self-reported trait anxiety and that trait anxiety did not interact with presentation order condition, the STAI-T scores were subjected to an analysis of variance (ANOVA) with anxiety group (clinical; HTA, shock threat; HTA, shock safe; LTA, shock threat; LTA, shock safe) and presentation order (unmasked first vs masked first) as the between group variables and STAI-T scores as the dependent variable. The results revealed a significant main effect of anxiety group, F (4, 150) = 155.93, MSE = 23.96, $p < .001$, $\eta_p^2 = .81$. A linear contrast showed that the clinically anxious participants (M = 55.25) reported significantly higher trait anxiety compared to their non-clinical HTA (shock threat, M = 46.16 and shock safe, M = 44.13) counterparts, t (155) = 9.53, $p < .001$, and the HTA group reported significantly higher trait anxiety than their LTA (shock threat, *M* = 30.99 and shock safe, *M* = 30.47) counterparts, *t* (155) = 17.12, $p < .001$. Importantly, there was no significant difference in self-reported trait anxiety between the shock threat and the shock safe conditions for the HTA group, *t* (155) = 1.66, *p* = .099, *ns*, and the LTA group, *t* (155) = .230, *p* = .819, *ns*. There were no other significant main effects or interactions, all $F < 1.67$, *ns*.

To assess for differences in self-reported state anxiety, depression, social desirability and age, the data were subjected to the same statistical analysis with STAI-S, BDI, MCSDS scores and age of participants as the dependent variables. The analysis of the STAI-S scores revealed a significant difference in self-reported state anxiety scores between the anxiety groups, *F* (4, 150) = 48.89, *MSE* = 57.17, $p < .001$, $\eta_p^2 = .52$. A linear contrast showed that the clinically anxious participants (*M* = 50.25) reported significantly higher state anxiety compared to their non-clinical HTA (shock threat, *M* = 42.53 and shock safe, *M* = 41.97) counterparts, *t* (155) = 4.92, $p < .001$, and the HTA group reported significantly higher state anxiety than their LTA (shock threat, *M* = 31.03 and shock safe, *M* = 30.00) counterparts, *t* (155) = 8.83, $p < .001$.

There were no other significant main effects or interactions, all $F < .78$, *ns.* There was no significant difference in self-reported trait anxiety between the shock threat and the shock safe conditions for the HTA group, *t* (155) = .30, *p* = .765, *ns*, or the LTA group, *t* (155) = .55, *p* = .58, *ns*. The analysis of the BDI scores revealed a significant difference in self-reported depression scores between the anxiety groups, *F* (4, 150) = 27.54, *MSE* = 32.38, $p < .001$, $\eta_p^2 = .40$. A linear contrast showed that the clinically anxious participants reported significantly higher depression (*M* = 16.34) compared to their non-clinical HTA (shock threat, *M* = 11.59 and shock safe, *M* = 9.22) counterparts, *t* (155) = 4.87, $p < .001$, and the HTA group reported significantly more depression than their LTA (shock threat, *M* = 3.72

and shock safe, $M = 4.22$) counterparts, $t\ (155) = 6.46$, $p < .001$. There were no other significant main effects or interactions, all $F < .45$ *ns*. There was no significant difference in self-reported depression between the shock threat and the shock safe conditions for the HTA group, $t\ (155) = 1.69$, $p = .059$ *ns*, or the LTA group, $t\ (155) = .36$, $p = .723$, *ns*.

An analysis of the MCSDS scores revealed no difference in self-reported social desirability between the anxiety groups or presentation orders and no interactions involving these two variables, all $F < 2.11$, *ns.* An analysis of the age of participants revealed a significant main effect of anxiety group, $F\ (4, 150) = 4.22$, $MSE = 54.39$, $p = .003$, $\eta_p^2 = .10$. A linear contrast showed that the clinically anxious participants were significantly older (M = 27.78 years) than their non-clinical HTA (shock threat, M = 23.78 years and shock safe, M = 24.47 years) counterparts, $t\ (155) = 2.29$, $p = .023$, with no differences in age between the HTA group and their LTA (shock threat, M = 20.25 years and shock safe, $M = 24.41$) counterparts, $t\ (155) = 1.381$, $p = .169$, *ns*. There was no significant difference in age between the shock threat and the shock safe conditions for the HTA group, $t\ (155) = .374$, p = 709, *ns*, whereas in the LTA group those in the shock safe condition were significantly older than those in the shock threat condition, $t\ (155) = 2.26$, $p = .025$. A bivariate correlation revealed that age and RT were not significantly correlated, all $r < .117$, all $p > .139$. There were no other significant main effects or interactions, all $F < 1.11$, *ns.* A chi square analysis revealed that gender was not disproportionately distributed among the anxiety groups, $\chi^2\ (4) = 6.48$, $p = .166$, *ns.* These findings confirm that the sample of participants met the screening criteria and were appropriate for inclusion in the experimental trials.

Table 4.1.

Study 1. Means and Standard Variations for Questionnaire and Age Variables

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	22.44	(5.98)	26.37	(12.48)	20.88	(3.88)	19.63	(1.50)
STAI-T	30.19	(3.47)	30.75	(3.04)	29.44	(4.72)	30.94	(3.92)
STAI-S	28.81	(7.49)	31.19	(5.44)	30.19	(6.82)	31.88	(7.33)
BDI	3.69	(3.88)	4.75	(3.91)	3.75	(3.00)	3.69	(2.82)
MCSDS	5.93	(1.69)	6.63	(2.25)	4.94	(1.44)	5.81	(1.87)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	25.06	(7.79)	23.88	(6.71)	23.00	(4.97)	24.56	(7.50)
STAI-T	42.94	(3.30)	45.31	(6.36)	45.06	(7.25)	47.25	(5.35)
STAI-S	42.38	(9.51)	41.56	(8.12)	42.44	(8.79)	42.63	(8.11)
BDI	8.50	(4.93)	9.34	(7.06)	11.00	(6.88)	12.19	(6.75)
MCSDS	6.13	(1.78)	6.31	(1.74)	6.88	(1.78)	6.25	(1.61)

	Clinically Anxious			
	Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)
Age (years)	29.31	(10.34)	26.25	(6.43)
STAI-T	56.06	(5.69)	54.44	(3.97)
STAI-S	52.06	(7.08)	48.44	(5.53)
BDI	17.25	(8.24)	15.44	(6.46)
MCSDS	6.31	(1.96)	6.50	(1.79)

Validity of state anxiety manipulation. To validate that the shock intensity was comparable between HTA and LTA groups, the data were subjected to a 2 X 2 ANOVA with trait anxiety (HTA vs. LTA) and presentation order (unmasked first vs. masked first) as the independent variables and shock intensity (volts) as the dependent variable. The clinically anxious group was not included in this analysis because they were not exposed to electric shocks. The results revealed comparable shock intensity between the LTA group (M = 20.86

V; *SE* = 3.15) and the HTA group (*M* = 22.97 V; *SE* = 3.15) and between the unmasked first group (*M* = 21.56 V; *SE* = 3.15) and the masked first group (*M* = 22.27 V; *SE* = 3.15), with no significant interaction, all $F < 1$, *ns*. The effectiveness of shock as a state anxiety induction method was validated by examining the HTA and LTA participants' responses on the ARQ with and without the threat of shock. The ARQ scores for the non-clinical sample were further compared to the ARQ scores for the clinically anxious sample. A single index of each dimension (nervousness, fearfulness, anxiousness) of the ARQ was obtained by averaging responses over the blocks of trials for the dimensions. Means and standard deviations of each scale on the ARQ for the HTA and LTA groups under the threat of shock and in the shock safe condition and for the clinically anxious group on the unmasked first and masked first presentation order conditions are reported in Table 4.2.

Table 4.2.

Study 1. Means and Standard Deviations of Responses in the Unmasked First and Masked First Presentation Order for Clinical and Non-Clinical, LTA and HTA Participants Under Shock Safe and Shock Threat Conditions on Three Dimensions of the Arousal Rating Questionnaire.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	1.21	(1.32)	0.88	(1.54)	-0.10	(1.33)	-0.17	(0.34)
Fearful – Fearless	1.50	(1.14)	1.63	(1.28)	-0.02	(1.30)	0.19	(1.20)
Anxious – Relaxed	1.13	(1.38)	0.56	(1.57)	-0.38	(1.30)	-0.38	(1.42)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	0.52	(1.38)	0.44	(1.14)	-1.13	(1.00)	-1.40	(1.28)
Fearful –Fearless	0.85	(1.26)	0.81	(1.14)	-1.00	(.93)	-1.10	(1.29)
Anxious – Relaxed	0.17	(1.61)	0.44	(1.20)	-0.30	(1.00)	-1.38	(1.33)

	Clinically Anxious			
	Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)
Nervous – Calm	-0.60	(0.90)	-0.60	(1.04)
Fearful – Fearless	-0.35	(1.10)	-0.23	(1.07)
Anxious – Relaxed	-0.94	(1.01)	-0.75	(1.28)

Note. Negative scores reflect greater nervousness, fearfulness and anxiety, whereas positive scores reflect less nervousness, fearfulness and anxiety.

The ARQ data were analysed using 5 X 2 ANOVAs with anxiety group (LTA, shock safe; LTA, shock threat; HTA ,shock safe; HTA, shock threat; clinically anxious) and presentation order (unmasked first vs. masked first) as the between subject factors, and nervousness, fearfulness and anxiousness dimensions as the dependent variables.

On the nervousness dimension, the only significant result to emerge was a significant main effect of anxiety group, *F* (4, 150) = 16.78, *MSE* = 1.34, *p* < .001, η_p^2 = .31. A linear contrast showed that those in the shock threat group (HTA, *M* = -1.18; LTA, *M* = -0.03) reported comparable nervousness to the clinically anxious participants (*M* = -0.64), *p* = .89, *ns*, but significantly more nervousness than their shock safe counterparts (HTA, *M* = 0.33; LTA, *M* = 0.94), *t* (155) = 6.13, *p* < .001. There were no other main effects or interaction, all *F* < 1, *ns*.

On the fearfulness dimension, the only significant result to emerge was a main effect of anxiety group, *F* (4, 150) = 21.84, *MSE* = 1.2, *p* < .001, η_p^2 =.368. A linear contrast showed that those in the shock threat group (HTA, *M* = -0.88; LTA, *M* = 0.18) reported comparable fearfulness to the clinically anxious participants (*M* = -0.27), *p* = .79, *ns*, but significantly more fearfulness than their shock safe counterparts (HTA, *M* = 0.78; LTA, *M* = 1.45), *t* (155) = 7.68, *p* < .001. There were no other main effects or interaction, all *F* < 1, *ns.*

On the anxiousness dimension, the only significant result to emerge was a main effect of anxiety group, *F* (4, 150) = 13.18, MSE=1.51, *p* < .001, η_p^2 =.260. A linear contrast showed that those in the shock threat group (HTA, *M* = -1.20; LTA, *M* = -1.72) reported comparable anxiousness to the clinically anxious participants (*M* =-0.84), *p* = .57, *ns*, but significantly more anxiousness than their shock safe counterparts (HTA, *M* = 0.23; LTA, *M* = 0.76), *t* (155) = 5.46, *p* < .001. There were no other main effects or interaction, all *F* < 1, *ns.*

Validity of masking procedure in preventing awareness. To validate that the SOAs on masked trials were comparable between groups, the data were subject to a 5 X 2 ANOVA with anxiety group and presentation order as the between group variables and SOAs as the dependent variable. The results revealed comparable SOAs between all groups, all *F* <

3.32, $p > .071$, *ns.* Table 4.3 presents SOA means and standard deviations for each group. The data therefore suggest that on the masked trials, all groups performed under comparable exposure durations.

To ensure that participants remained unaware of stimuli on masked trials, the final awareness check data was subject to a 5 X 2 ANOVA with anxiety group and presentation order as the between subject variables and percent of correct responses as the dependent variable. Table 4.4 show the mean percentage of correct responses on the final awareness check trial for all groups. The data suggest that the percentage of correct responses on the final awareness check for all anxiety groups in both presentation order conditions was comparable, all $F < 2.26$, $p > .066$, ns., and the performance of these groups as a whole (M = 18.98; SD = 3.04) did not differ from that expected by chance (20; i.e., 50%), $z = .34$, *ns*. The data suggest that participants were unaware of the stimuli on the masked trials.

Table 4.3.

Study 1. Means and Standard Deviations of SOAs (msec) on Masked Trials and Correct Responses (%) on the Final Awareness Check Trial for Five Anxiety Groups in the Unmasked First and Masked First Exposure Conditions.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
SOA (msec)	10.31	(6.70)	25.63	(24.21)	14.69	(14.69)	16.25	(16.78)
Correct Responses (%)	44.69	(6.49)	46.10	(6.58)	45.16	(6.29)	46.88	(6.36)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
SOA (msec)	12.19	(13.41)	12.50	(15.06)	12.19	(12.19)	14.06	(15.83)
Correct Responses (%)	47.81	(7.79)	47.97	(10.13)	48.33	(9.94)	46.09	(8.11)
	Clinically Anxious							
	Unmasked First				Masked First			
Variable	M		(SD)		M		(SD)	
SOA (msec)	11.25		(11.18)		14.38		(15.69)	
Correct Responses (%)	47.50		(7.68)		43.31		(7.59)	

Data Reduction

The colour naming reaction time data was reduced in four stages prior to statistical analysis. Trials containing the following were excluded from analysis: (a) microphone failures (2.46 %); (b) colour naming errors (0.8 %); (c) responses less than 300 msec or more than 3000 msec (0.19 %); and (d) trials more than 2 SD from each cell mean (4.75 % of trials).

Error data. The percentage of errors in each experimental condition is shown in Table 4.4. Colour naming error data were analysed using a 5 X 2 X 2 X 2 mixed ANCOVA with valence (neutral vs. threat) and exposure mode (masked vs. unmasked) as the within subject variables, anxiety group (LTA, shock safe; LTA, shock threat; HTA, shock safe; HTA, shock threat) and presentation order (masked first vs. unmasked first) as the between subject variables. The BDI scores were entered as the covariate. The dependent variable was colour naming errors. The data did not reveal any significant main effects or interaction, all $F < 1.89$, *ns*.

Reaction Time Data

Mean RTs for each experimental condition were calculated and are shown in Table 4.5. The RT data were analysed using an equivalent design to the error data.

Table 4.4.

Study 1. Means and Standard Deviations of Error Percentages in Colour Naming Masked and Unmasked Neutral and Threat words for 5 Experimental Groups When Presented with Unmasked First and Masked First Presentation Order.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Neutral Words	0.78	(1.51)	1.09	(1.82)	0.63	(1.44)	0.16	(0.63)
Threat Words	0.78	(1.20)	0.36	(1.12)	0.63	(1.12)	0.31	(0.85)
Unmasked								
Neutral Words	0.94	(1.25)	0.78	(1.20)	0.63	(1.44)	1.25	(2.74)
Threat Words	0.47	(1.01)	0.31	(1.25)	1.09	(1.28)	0.31	(1.25)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Neutral Words	0.78	(1.20)	0.47	(1.01)	1.09	(2.03)	0.78	(1.20)
Threat Words	0.78	(1.20)	1.09	(1.28)	0.94	(1.25)	0.63	(1.12)
Unmasked								
Neutral Words	0.47	(1.36)	1.56	(1.55)	0.63	(1.44)	0.47	(1.01)
Threat Words	1.03	(1.57)	1.25	(1.83)	1.56	(2.56)	1.88	(2.14)

	Clinically Anxious			
	Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)
Masked				
Neutral Words	0.63	(1.71)	0.47	(1.01)
Threat Words	0.47	(1.01)	0.31	(0.85)
Unmasked				
Neutral Words	1.09	(1.82)	0.78	(1.20)
Threat Words	1.41	(2.23)	0.78	(1.76)

Table 4. 5.

Study 1. Means and Standard Deviations of Colour Naming Reaction Times in Milliseconds for Masked and Unmasked Neutral and Threat Words for 5 Anxiety Groups for the Unmasked First and Masked First Presentation Order.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Neutral Words	816	(67)	883	(105)	837	(67)	807	(59)
Threat Words	816	(72)	878	(101)	841	(69)	811	(60)
Unmasked								
Neutral Words	867	(83)	941	(127)	920	(93)	920	(108)
Threat Words	874	(87)	941	(130)	921	(94)	929	(115)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Neutral Words	816	(72)	831	(76)	871	(88)	815	(75)
Threat Words	816	(67)	841	(81)	894	(109)	812	(75)
Unmasked								
Neutral Words	859	(81)	898	(96)	907	(104)	916	(113)
Threat Words	868	(84)	910	(118)	923	(117)	916	(143)

	Clinically Anxious			
	Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)
Masked				
Neutral Words	836	(68)	850	(64)
Threat Words	853	(100)	848	(70)
Unmasked				
Neutral Words	917	(107)	927	(99)
Threat Words	918	(119)	950	(124)

The results revealed a significant main effect of Valence, F (1, 149) = 5.10, MSE = 593.23, p = 025, η_p^2 =.050, with longer colour naming RTs to threat words (M = 879 msec;

SE = 7.36) compared to the neutral words (*M* = 872 msec; *SE* = 6.57), and a significant main effect of exposure mode, *F* (1, 149) = 38.14, *MSE* = 4381.68, $p < .001$, $\eta_p^2 = .200$, with longer colour naming RTs on unmasked trials (*M* = 912 msec; *SE* = 6.12) compared to the masked trials (*M* = 839 msec; *SE* = 8.48). This main effect was further qualified by a significant Exposure Mode X Presentation Order Interaction, *F* (1, 149) = 8.34, *MSE* = 4381.68, *p* =. 004, η_p^2 =.050. As can be seen in Figure 4.2, averaged over valence and anxiety group, the interaction reflects the fact that there was no difference in colour naming RTs on masked trials between the unmasked first (*M* = 839 msec; *SE* = 8.91) and masked first (*M* = 838 msec; *SE* = 8.91) presentation order, *p = .89, ns* whereas on the unmasked trials a marginally significant finding revealed longer colour naming RTs in the masked first condition (*M* = 926 msec; *SE* = 11.90) compared to the unmasked first condition (*M* = 897 msec; *SE* = 11.90), *F* (1, 157) = 2.90, *p* = .090, $\eta_p^2 = .018$. There were no other main effects or interactions, all *F* < 2.412, *ns.*

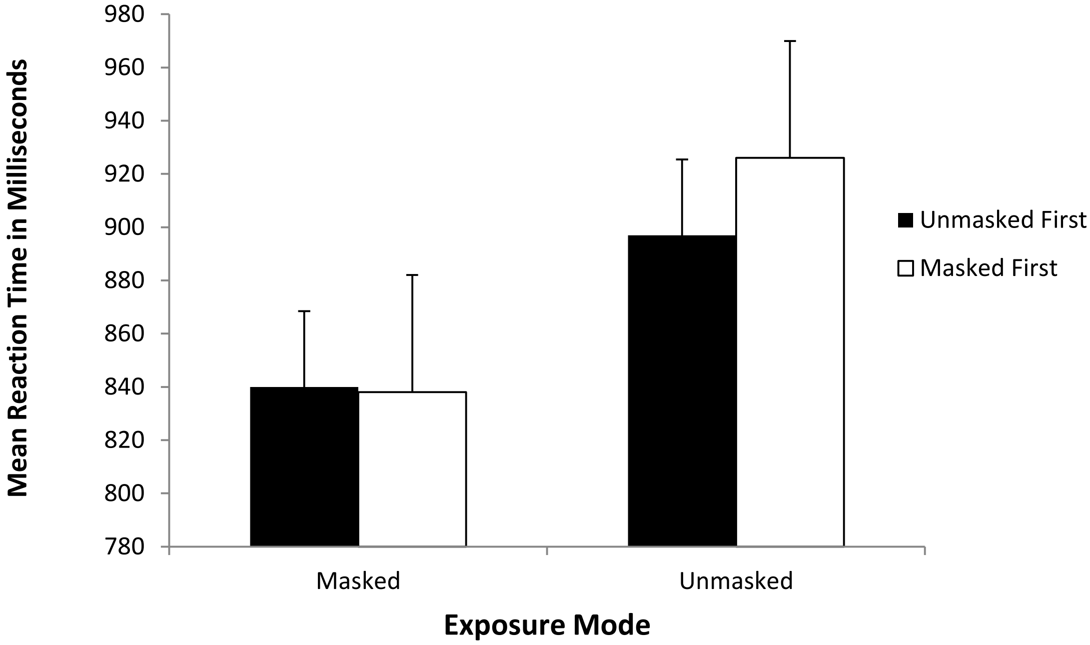

Figure 4.1. Study 1. Mean colour naming reaction times in milliseconds for masked and unmasked words for the unmasked first and masked first presentation order averaged over valence and anxiety group. Vertical bars represent standard errors of the mean.

Discussion

The purpose of this chapter was to examine a number of central assumptions proposed by the theoretical models described in Chapter 1 (Clark & Beck, 2010; Mogg & Bradley, 1998; Öhman & Mineka, 2001). The models propose that anxiety is characterized by an attentional bias for threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. In addition, this chapter further aimed to investigate the hypothesis proposed by Öhman (1993) who emphasised priming of threat during conscious processes to elicit attentional biases for threat at preattentive levels.

The aim of the present study was to investigate whether priming of threat is a necessary precondition to elicit preconscious threat biases in clinical vs. non-clinical samples. To investigate selective processing of threat in anxiety, the present study employed threat related and non-threat related words with a sample of clinically anxious and non-clinical HTA and LTA participants. To investigate the 'involuntary' component of the automaticity hypothesis, the current study employed an interference paradigm (emotional Stroop colour naming task), and to investigate the 'without awareness' component of the automaticity hypothesis, verbal stimuli were presented within (unmasked) and outside (masked) of conscious awareness. To investigate the role of priming in moderating selective processing of masked threat, the current study blocked on exposure mode presentation order, such that half of participants within each anxiety group received masked trials followed by unmasked trials, whereas the remaining half received the opposite order. The study further aimed to investigate the relative influence of state and trait anxiety in moderating threat processing biases. To achieve this, non-clinically anxious participants were allocated to a trait anxiety group (HTA vs. LTA), then half of the participants within each trait anxiety group performed under the threat of shock, whereas the remaining half performed under shock safe conditions.

If priming is not needed to elicit preconscious threat processing effects, then in line with Clark and Beck (2010) and Mogg and Bradley (1998), it was predicted that clinically anxious and HTA relative to LTA participants would be slower to colour name masked and unmasked threat words relative to neutral words irrespective of whether masked or unmasked trials were presented first, but only while performing under the threat of shock (HTA group). On the other hand, if priming is needed to elicit masked threat processing effects, then in line with Öhman and Mineka (2001) it was predicted that HTA relative to LTA participants would be slower to colour name masked threat words relative to neutral words but only when performing under the threat of shock and only when unmasked trials were presented before the masked trials. Further, if selective processing of masked threat is a marker of clinical anxiety, then it was predicted that clinically anxious relative to non-clinical participants would be slower to colour name masked threat words relative to neutral words irrespective of whether masked trials or unmasked trials are presented first.

The data from the present study provided partial support for the first prediction. Irrespective of shock condition (non-clinical groups only), and whether masked trials or unmasked trials were presented first, all participants were slower at colour naming masked and unmasked threat words relative to non-threat words. These findings were at odds with the prediction of all theoretical models described in Chapter 1. The findings were also in discord with studies (e.g., Bradley, Mogg, Millar & White, 1995; Harvey, Bryant & Rapee, 1996; Mogg, Bradley, Williams & Mathews, 1993a) that employed the emotional Stroop colour naming task with intermixed presentations of masked and unmasked verbal stimuli and found that selective processing of masked and unmasked verbal threat was only evidenced in their clinically anxious participants relative to their non-anxious controls. However, the aforementioned studies did not assess for the role of priming in moderating these effects because masked and unmasked trials were presented intermixed, nor did they provide information regarding the relative influence of state and trait anxiety in their non-clinical sample of participants.

Nonetheless, data from studies that have accounted for these limitation, (Fox, 1996, Experiment 3; Edwards et al., 2010b) by manipulating state anxiety and blocking on exposure found that irrespective of state anxiety, and only when unmasked trials were presented first, HTA relative to the LTA participants selectively processed both masked and unmasked threat relative to neutral words. In line with Öhman (1993) these findings suggest that priming of threat is a necessary precondition to elicit preconscious threat bias in clinically anxious and non-clinical HTA participants. In the current study, given that masked threat processing biases were observed under conditions that controlled for conscious awareness of threat items, these data suggest that masked threat processing effects were not moderated by priming. To date no known studies have reported selective bias for verbal threat in anxiety when masked trials were presented before the unmasked trials.

In an attempt to understand the discordant finding all manipulation checks were reviewed. Linear contrasts confirmed that clinically anxious participants reported significantly more trait anxiety, state anxiety and depression compared to the HTA group, and the HTA group reported significantly more trait anxiety, state anxiety and depression compared to the LTA group. Care was taken to control for depression during statistical analysis on the RT data, indicating the data cannot be accounted by depression. The findings further revealed that shock intensity was comparable between the HTA and LTA groups. The findings also revealed comparable and within criterion MCSDS scores between groups. These findings confirm effective experimental controls on the aforementioned variables.

Investigation of the ARQ data revealed that clinically anxious participants reported similar levels of nervousness, fearfulness and anxiousness to both HTA and LTA groups in the shock threat conditions but higher than the HTA and LTA participants in the shock safe groups. Therefore, if threat processing biases are moderated by state anxiety, then these findings could explain why there was no significant difference in threat processing between the clinically anxious and shock threat groups. However, given that threat processing biases were observed irrespective of shock threat condition, it is unlikely that this factor contributed to the discordant findings.

The data from the present study was mixed for the central assumptions proposed by the theoretical models described in Chapter 1 (Clark & Beck, 2010; Mogg & Bradley, 1998; Mineka, 2001). Although the present study found evidence for the automatic nature of selective processing of threat, masked processing of threat was observed across all participants and irrespective of exposure order. Therefore on the basis of current findings, selective processing of masked threat was not moderated by state or trait anxiety. Further, given that masked threat effects were not reliant on priming of threat during conscious processes to elicit selective attention at preattentive levels, these data are in opposition to Öhman's (1993) priming hypothesis and at discord with others (e.g., Edwards, Burt & Lipp, 2010b; Fox, 1996, Experiment 3).

A possible explanation for these puzzling finding is attributed to a possible discrepancy in perceptual threshold for threat stimuli between the HTA, LTA and clinical participants. That is, it may be that LTA participants may have a comparable awareness threshold for subliminal neutral stimuli to their HTA and clinical counterparts. They also may be characterised by lower perceptual threshold for detecting subliminal threat. LTA individuals may engage in increased threat processing similar to their HTA and clinically anxious counterparts but may just as quickly dismiss the threatening information. This interpretation however is speculative but remains to be tested.

Further, although there is compelling evidence to suggest that anxiety is characterised by an automatic attentional bias to threat, word stimuli are relatively limited in threat value and evolutionary relevance (Mogg & Bradley, 1998), therefore the findings from studies employing words as stimuli cannot be used to make predictions about attention allocations for more ecologically valid, pictorial stimuli (e.g.,, snakes, threatening scenes, angry faces). Therefore, for the purpose of this investigation, the following series of studies employed schematic representations of happy, neutral and threat faces as stimuli.

Chapter 5

Automaticity of Attentional Bias to Pictorial Threat in Anxiety: Emotional Stroop Colour Naming Task

The purpose of the present chapter was to investigate the automaticity of selective attention for masked and unmasked pictorial threat in non-clinical, high trait anxious (HTA) and low trait anxious (LTA) participants in line with the theoretical models described in Chapter 1. The chapter will further aim to investigate the priming hypothesis proposed by Öhman (1993). In line with Study 1, the studies reported in this chapter will employ the emotional Stroop colour naming task for the purpose of this investigation (See Chapters 2 and 4). The current methodology differed from Study 1 in the following ways: (1) stimuli consisted of happy, natural and threat schematic faces, and these stimuli have been effectively employed in previous research investigating selective processing of pictorial threat in anxiety (e.g., Öhman et al., 2001); (2) a clinically anxious sample was not included. The aim of the following series of studies was to investigate the relative influence of state and trait anxiety in moderating selective processing for pictorial threat and including a clinical sample was beyond the scope of the current investigation; (3) Study 2.2 employed masked and unmasked stimuli intermixed to compare the role of awareness in threat processing of pictorial stimuli against the block design employed in Study 2.1.

This methodology therefore allowed for investigating (1) selective processing of pictorial threat in non-clinical HTA and LTA individuals; (2) attention to pictorial threat without volition; (3) attention to pictorial threat without awareness; (4) the role of priming in moderating attentional allocation to pictorial threat at preattentive levels; (5) the relative influence of state and trait anxiety on selective processing of pictorial threat and; (6) the nature of awareness in selective processing of threat faces compared to the selective processing of words employed in Study 1. In Study 1, the findings revealed that priming was not a precursor for eliciting selective attention to threat words at preattentive levels.

These investigations were deemed important because the current body of empirical literature investigating the role of awareness on selective processing of pictorial threat is limited in several ways. First, only a limited number of studies have employed interference paradigms with schematic faces. Thus, this investigation was deemed significant because interference paradigms are capable of assessing both the without awareness and without volition components of the automaticity hypothesis. Second, the current body of literature employing interference paradigms with masked pictorial stimuli is methodologically limited and did not find evidence for selective processing of pictorial threat at preattentive levels in their trait anxious individuals (see Chapter 2). Attentional biases for masked pictorial threat have been observed in studies employing dot probe paradigms, however, the findings were mixed and could not confirm the involuntary nature of the automaticity hypothesis (see Chapter 2). The following section will summarise the key elements under investigation.

Summary of Literature

According to theories of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) anxiety is characterized by an attentional bias to threat that is automatic in that it is involuntary and occurs outside of conscious awareness. Öhman (1993) further proposes that conscious processing of threat is required to prime the mechanism responsible for processing threat at preattentive levels. In relation to the relative influence of state and trait anxiety in moderating these effects, Clark and Beck (2010) place emphasis on the role of trait anxiety, whereas, Öhman and Mineka (2001) place greater emphasis on state anxiety, on the other hand, Mogg and Bradley (1998) place emphasis on both state and trait anxiety.

Although there is evidence in support of selective processing of pictorial threat in clinically anxious and non- clinical HTA and LTA individuals (e.g., Bradley, Mogg, Fella & Hamilton, 1998; Bradley et al., 1998; Byrne & Eysenck, 1995; Galboa-Schechtman et al., 1999; Koster, Crombez, Verscuere & Houwer, 2006; Lee & Knight, 2009; Mogg & Bradley, 1999a; Mogg, McNamara, Powys, Rawliston, Seiffer & Bradley, 2000; Wilson & MacLeod, 2003), the methodological nature of the tasks employed do not allow for investigation of the involuntary or without awareness component of the automaticity hypothesis, which are central to the models under investigation. Despite the limited number of studies investigating the “without volition” component of the automaticity hypothesis, there is some evidence for the involuntary nature of selective processing of threat faces as a function of high trait anxiety (Avram, Balteş, Miclea, Miu, 2010) and as a function of increased state anxiety (Robson, Letkiewicz, Overstreet, Ernst and Grillon, 2011). However, these studies were limited in several ways: (1) Robson et al. (2011) did not investigate the role of trait anxiety in moderating these effects; (2) Avram et al., (2010) did not provide information regarding the influence of state anxiety on selective processing for pictorial threat; (3) the studies varied on task demands (e.g., name face vs. read word), yet both found that the HTA and high state anxious participants’ attention was captured by the threat related content relative to threat related words; (4) neither study was able to provide information on the role of awareness in threat processing because both studies presented stimuli unmasked.

At this time only two studies capable of assessing the role of awareness in selective processing of pictorial threat on the emotional Stroop colour naming task could be located (Putman, Hermans & van Honk, 2004; van Honk, Tuiten, de Haan, van den Hout & Stam, 2001), and both failed to find evidence for selective processing of masked or unmasked pictorial stimuli as a function of trait anxiety. These findings are puzzling given that others employing the emotional Stroop with pictorial stimuli have found unmasked threat processing effects as a function of trait anxiety (Avram et al., 2010) and state anxiety (Robson et al., 2011). Studies employing the dot probe methodology also found unmasked (e.g., Mogg, Garner & Bradley, 2007) and masked (e.g., Lee & Knight, 2009) processing biases for pictorial threat as a function of trait anxiety. A number of limitations identified with von Honk et al. (2001) and Putman et al. (2004) could have contributed to the differential findings. First, the discrepancy in data for the unmasked trials on the emotional Stroop task could be attributed to the different types of stimuli employed and the variation in task demands. The discrepancy in data for the masked trials could be attributed to the lack of state anxiety manipulation, the relatively long SOA and differences in task demands employed. It is also likely that person variables could have contributed to the lack of significant threat processing biases between the studies. See Chapter 2 for a more detailed discussion of these accounts.

To control for a number of limitations associated with the aforementioned studies and in an attempt to overcome some of the interpretational difficulties associated with these tasks, the studies included in this chapter employed the emotional Stroop colour naming task with schematic representation of happy, neutral and threat faces. A non-clinical sample of HTA and LTA participants was employed, and half of each trait anxiety group were exposed to the threat of shock, whereas the other half were assigned to the shock safe condition. Masked and unmasked schematic faces were blocked on exposure (Study 2.1), such that half of the participants received masked trials first followed by unmasked trials, whereas the other half received the opposite order. In Study 2.2, masked and unmasked faces were presented intermixed. Awareness checks were conducted in both studies by way of a face/non-face discrimination task.

Study 2.1

Individual Differences in Attention for Blocked Masked and Unmasked Emotionally Toned Faces in Anxiety With and Without the Threat of Shock on the Emotional Stroop Colour Naming Task.

Aim of Study

The aims of the current study were to: (1) investigate whether the presentation of schematic faces would be associated with differential patterns in attentional allocation to threat faces between the HTA and LTA participants compared to the attentional bias for threat words observed across all participants in Study 1; (2) assess the role of awareness in moderating these effects; and (3) investigate whether priming is a precursor for threat processing at preattentive levels by presenting masked and unmasked trials blocked on exposure.

Hypotheses

Following the theoretical positions under investigation, several specific predictions were made. First, if priming is not needed to elicit preconscious threat processing effects, then in line with Clark and Beck (2010) it was predicted that HTA relative to LTA participants would be slower to colour name masked and unmasked threat faces relative to non-threat faces irrespective of whether masked or unmasked trials were presented first, but only while performing under the threat of shock. However, if priming is needed to elicit masked threat processing effects, then in line with Öhman (1993) it was predicted that HTA relative to LTA participants would be slower to colour name masked threat faces relative to masked neutral faces, but only when performing under the threat of shock, and only when unmasked trials were presented before the masked trials. If the schematic threat faces do carry more threat value than threat words then in line with Mogg and Bradley (1998) and Öhman and Mineka (2001), it was predicted that HTA and LTA participants would be slower to colour name masked and unmasked threat faces relative to neutral or happy faces but only when performing under the threat of shock and only when unmasked trials are presented before the masked trials.

Method

Participants

A sample of 167 Bond University students, staff and Gold Coast community volunteers participated in this study. Chapter 3 details the incentives for participating and screening criteria. Of those who met initial screening criteria, one participant was excluded due to above criterion scores on the depression scale, and 10 participants were excluded due to high social desirability scores. These participants were thanked, given their incentive, a handout detailing the nature of the study, and released. Of those included in the experimental phase, data from a further 28 participants was excluded due to their performance on the final awareness check.

One hundred twenty eight participants, 44 male and 84 female, aged 18 years to 65 years (M = 30.04 years; SD =14.5) made up the final sample. Participants were allocated to the trait anxiety group (64 LTA, 64 HTA) following the same procedure used in Study 1. That is, those who scored 36 or below on the STAI-T were assigned to the LTA group and those who scored 37 and above were assigned to the HTA group. Based on their order of arrival at the laboratory, half of the participants within each anxiety group were randomly allocated to the shock threat (n = 64) and shock safe (n = 64) conditions, and half the participants in these groups were randomly allocated to the presentation order conditions (masked first, *n* = 64; unmasked first, *n* = 64). The allocation to conditions resulted in 16 participants being allocated to each experimental group.

Apparatus

Details for the experimental hardware, software and shock stimulus used in Study 2.2 are presented in Chapter 3 above.

Materials

Face Stimuli. Details on the face, non-face and mask stimuli used in the practice trials, colour naming trials and final awareness check trials in Study 2.1 are presented in Chapter 3 above.

Psychometric Measures

All participants completed the STAI, DASS-D, MCSDS and ARQ. Chapter 3 provides a detailed description of each questionnaire including psychometric properties, scoring and inclusion/exclusion criteria.

Design

A 3 X 2 X 2 X 2 X 2 mixed design was used for the study. The within subjects factors were valence (happy face vs. neutral face vs. threat face) and exposure mode (masked vs. unmasked). The between subjects factors were trait anxiety group (HTA vs. LTA), shock group (shock threat vs. shock safe) and presentation order (masked first vs. unmasked first). The dependent variables were colour naming reaction times and colour naming errors.

Procedure

The SOA threshold was pre-determined at 15 msec to prevent the possibility of SOA setting trials priming responses on experimental trials. SOA of 15 msec was chosen because previous studies have shown that SOAs have precluded awareness of masked pictorial stimuli (e.g., 14 msec, Harvey et al. 1996; 14 msec & 17 msec, Mogg & Bradley, 1999a, Experiment 1 & Experiment 3, respectively; 14 msec, Mogg et al., 1993a; 20 msec, MacLeod & Rutherford, 1992).

Shock intensity setting. In line with study 1, participants who were assigned to the shock threat group underwent a procedure to set the shock intensity. Shock intensity was set individually for each participant (see Study 1 for procedural details).

Practice trials. Prior to starting the practice block, all participants received standard instructions. They were informed to name the colour of the stimulus as quickly and accurately as possible while ignoring the emotional content of the stimulus. All participants completed a practice block of 24 trials to familiarize themselves with the experimental task. On each trial, they were presented with a row of three white crosses in the centre of the screen for one second. The crosses served as a fixation point for the stimuli. The screen was then blanked for 250 msec and replaced by either a red, green, blue or yellow non-face in the location formerly occupied by the crosses. Half of the stimuli were presented unmasked whereas the other half were presented masked. On the unmasked trials, the non-face would remain on the screen until the participants' first vocal response was detected by the experimental software. On the masked trials, the stimulus was presented for 15 msec and was replaced by a mask of the same colour. The mask remained on the screen until the participant's first vocal response was recorded. The experimenter coded accuracy of the participant's response on a separate monitor. Any responses that indicated the colour of the stimulus were coded as "correct", and "incorrect" if the initial response was not a clear identification of the colour of the stimulus (e.g., if the participant stuttered, or named the wrong colour). Any responses that failed to be recorded by the experimental software were coded as a "microphone failure". After the experimenter coded the responses the next trial was initiated, with an average two second inter-trial interval.

On the practice trials, half of the stimuli (non-faces) were presented unmasked and half were masked. The order of presentation was quasi-randomised but governed by the restriction that not more than two presentations of the same exposure, colour, or item occurred in succession. Each stimulus type was presented eight times in each block of 24 trials, four times masked and four times unmasked, six times in each colour, and each stimulus was assigned to each mask once. Each mask was presented three times across 12 trials and appeared in the same colour across all presentations. Across a block of 24 trials, each colour was presented six times and each colour was assigned to each mask six times (three times masked and three times unmasked). The combination of targets, colours and masks was such that none of these combinations occurred more than once within the block.

Following the practice trials, all participants received a three minute rest period. Those in the shock threat group had the electrode re-attached, and were informed that the computer would randomly deliver between five and seven electric shocks across the four blocks of experimental colour naming trials. In reality, the experimenter delivered the electric shocks and only five electric shocks were administered for the remainder of the experiment. The first electric shock was delivered at the same intensity previously set during the shock intensity setting procedure and was administered approximately 15 seconds prior the first experimental colour naming trial. This procedure was employed to increase the likelihood that participants believed the instructions given to them.

Colour naming trials. Four blocks of 24 colour naming trials were administered. In each block three schematic faces (happy, neutral, threat) were presented in red, green, blue or yellow colouring, four times masked, and four times unmasked. On the unmasked trials, the face would remain on the screen until the participants' first vocal response was recorded by the experimental software. On the masked trials, the face was presented for 15 msec and replaced by a mask of the same colour. Participants who were assigned to the unmasked first condition received two blocks of 24 unmasked trials first followed by two blocks of masked trials. The masked first group received the opposite presentation order. The experimental procedure relating to participant standard task demands, instructions, recording and scoring of responses was the same as in the practice trials.

In line with the practice trials, stimulus presentations were quasi-randomized with the restrictions that no more than two consecutive trials of the same face type and colour were presented in a block of 24 trials. In a block of 24 trials, each face type was presented eight times and with each colour twice. Each face type was presented with each mask four times across two blocks of 24 trials. Each mask was presented 6 times in a block of 24 trials. Across two blocks of 48 trials, each mask was presented with each face type four times, and in each colour three times. Across a block of 24 trials, each colour appeared six times and twice with each face type, and three times with each mask across two blocks of 48 trials. To control for potential differences in valence between the masks, each was presented in only one colour for each participant, but the assignment of colours to masks was fully counterbalanced across participants. Across four versions of stimulus sequencing, each combination of face type, colour and mask was presented once.

Prior to the first block of colour naming trials, participants completed the ARQ for the first time. A brief rest period followed before the colour naming trials commenced, and approximately 15 seconds prior to the initiation of the first trial in Block 1 those in the shock threat group received their first shock. On each experimental colour naming trial, participants were presented with a row of three white crosses in the centre of the screen for one second, the screen was than blanked for 250 msec and a neutral, happy or threat face appeared in either red, green blue or yellow colouring, in the location formerly occupied by the crosses.

The item remained on the screen until the first vocal response was detected by the experimental software. On the masked trials, a mask of the same colour replaced the schematic face after 15 msec and remained on the screen until the software recorded the first vocal response. Participants in the shock threat group received a second shock immediately after they indicated their final colour naming response in the first block. All participants completed the ARQ again during the rest time between Block 1 and 2 and those in the shock threat group received their third shock at this time. Block2 commenced once participants completed the questionnaire. During the rest period between Block 2 and 3participants filled out the third ARQ. Approximately 15 seconds prior to commencing block 3 of trials, those in the shock threat group received their fourth shock. The fifth and final eclectic shock was administered immediately following the participant’s vocal response for the final trial in Block 3. At this stage participants were anticipating up to two more shocks, when in reality this was the final shock to be administered. Participants completed the final ARQ at this time, after which the final block of trials was initiated. Once the final block was completed, those in the shock threat group had the electrode removed.

Awareness check trials. Following the completion of the four blocks of experimental colour naming trials, each participant completed a block of 48 awareness check trials to ensure that they remained unaware of the masked stimuli. In each block, 24 trials were faces and 24 were non-faces. On each trial, participants were presented with a row of three white crosses in the centre of the screen for one second, the screen was then blanked for 250 msec and replaced by either a red, green blue or yellow face or a non-face in the location formerly occupied by the crosses. After 15 msec the face/non-face was then replaced by one of four pattern masks of the same colour. The participants’ task was to indicate whether a face or a non-face preceded the mask by pressing a corresponding button on a keyboard. Participants were instructed to guess if they were unsure of the stimulus status.

The order of presentation was quasi-randomised with restrictions such that no more than two items of the same status and colour occurred in succession. Each block of 48 trials consisted of 24 faces and 24 non-faces. Each face type and non-face appeared in the block eight times and in each colour twice. Each mask appeared in the block 12 times and twice in each colour. Each colour appeared in the block 12 times and assigned to each stimulus type twice. Only data from those participants who scored 24 or fewer correct responses was retained because they were considered to have remained unaware of the masked stimuli during the experimental colour naming trials. The data for those who scored more than 25 correct responses was not included in the final analysis. At the conclusion of the task, all participants were thanked, debriefed and released.

Results

Manipulation Checks

Following Study 1, validation that groups were differentiated on trait anxiety was sought, as was verification of the effectiveness of the experimental manipulations, prior to statistical analysis of the colour naming reaction time data.

Validity of trait anxiety group status. To verify that the HTA and LTA participants significantly differed on self-reported trait anxiety, STAI-T scores were subjected to a 2 X 2 X 2 analysis of variance (ANOVA) with trait anxiety group (HTA vs. LTA), shock condition (shock save vs. shock threat) and presentation order (masked first vs. unmasked first) as the between subject variables and STAI-T scores as the dependent variable. The results revealed a significant main effect of trait anxiety, F (1, 120) = 231.16, MSE = 27.62, p < .001, η_p^2 = 658, with the LTA group (M = 30.61; SE = .66) reporting lower trait anxiety compared to their HTA counterparts (M = 44.73; SE = .66). There were no other main effects or interactions, all $F < 2.09$, $p > .151$ *ns.*

To assess for differences in self-reported state anxiety, depression, social desirability and age, the data for each were subject to separate ANOVAs of equivalent design to that above. On the STAI-S measure, the results revealed a significant main effect of trait anxiety, F (1, 120) = 72.51, MSE = 52.04, $p < .001$, $\eta_p^2 = .377$, with the LTA group (M = 27.33; SE = .90) reporting lower state anxiety than the HTA group (M = 38.12; SE =. 90). There were no other main effects or interactions, all $F < 3.07$, $p > .082$ *ns.* Assessment of the depression scale of the DASS measure also produced a significant main effect of trait anxiety, F (1, 120) = 32.11, MSE = 25.39, p < 001, $\eta_p^2 = .211$, with the LTA group (M = 2.58; SE = .63) reporting lower depression than the HTA group (M = 7.63; SE = .63). The data also yielded, a significant main effect of presentation order which was further qualified by a higher order Shock Condition X Presentation Order interaction, F (1, 120) = 4.51, MSE = 25.39, p = .036, $\eta_p^2 = .036$. Averaged over trait anxiety, the interaction reflects the fact that there was no difference in self-reported depression scores as a function of presentation order for those in the shock threat group, F (1, 124) = .01, MSE = 32, p = .930, $\eta_p^2 =$ 000 *ns,* whereas in the shock safe group, higher self-reported depression was noted in the unmasked first condition (M = 7.59; SE = 1.00) compared to the masked first condition (M = 3.69; SE = 1.00), F (1, 124) = 7.63, MSE = 32, p = .007, η_p^2 =.058.

Analysis of honest responses on the MCSDS measure revealed a significant main effect of trait anxiety group, F (1, 120) = 11.77, MSE = 3.16, p = .001, $\eta_p^2 = .089$, with the HTA counterparts (M = 7.25; SE = .22) responding more honestly with fewer socially desirable responses than their LTA group (M = 6.17; SE = .22). There were no other main effects or interactions, all $F < 3.03$, $p > .084$ *ns.* Further analysis revealed no significant difference in age of participants between conditions, all $F < 2.17$, all $p > .143$ *ns*. A chi square analysis revealed that gender was proportionately distributed among the anxiety groups, χ^2 (3) = 5.26, $p = .153$ *ns*. Table 5.1 shows the means and standard deviations for the measures.

Table 5.1

Study 2.1 Means and Standard Variations for Questionnaire and Age Variables

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	36.50	(16.56)	27.50	(11.06)	31.25	(17.33)	29.63	(14.89)
STAI-T	31.25	(4.84)	30.81	(3.92)	30.88	(3.98)	29.50	(4.84)
STAI-S	28.88	(5.23)	26.75	(7.24)	28.00	(4.69)	25.69	(4.66)
DASS-D	4.19	(4.51)	1.63	(1.67)	3.38	(6.01)	1.13	(1.45)
MCSDS	6.13	(1.82)	6.81	(1.72)	6.13	(1.63)	5.63	(1.41)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	27.00	(13.12)	24.75	(6.82)	29.87	(15.43)	33.81	(17.22)
STAI-T	46.81	(6.18)	44.25	(6.74)	43.00	(4.90)	44.88	(5.94)
STAI-S	41.56	(7.14)	35.31	(7.09)	37.06	(9.38)	38.81	(10.19)
DASS-D	11.00	(6.49)	5.75	(4.78)	5.88	(4.29)	7.88	(7.64)
MCSDS	7.38	(1.59)	7.63	(2.03)	6.75	(1.77)	7.25	(2.14)

Validity of state anxiety manipulation. To verify that shock intensity was comparable between groups, a 2 X 2 ANOVA was employed with trait anxiety (HTA vs LTA) and presentation order (masked first vs. unmasked first) as the between subject variables and shock intensity as the dependent variable. The result revealed comparable shock intensity between all groups, all $F < 2.17$, $p > .143$ *ns*. The effectiveness of the threat of shock as an anxiety induction method was validated by examining effect of the threat of shock on the ARQ dimensions in the trait anxiety and presentation order conditions. A single index on each dimension of the ARQ was obtained by averaging nervousness, fearfulness and anxiousness responses over the blocks of trials. Means and SDs of each scale on the ARQ for HTA and LTA groups under the threat of shock and in the shock safe condition on masked first and unmasked first blocks are reported below in Table 5.2

Table 5.2

Study 2.1 Means and Standard Deviations of Responses for HTA and LTA Participants on Three Dimensions of the Arousal Rating Questionnaire under Shock Safe and Shock Threat Conditions in the Unmasked First and Masked First Presentation Order.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	1.23	(1.06)	1.36	(1.44)	0.58	(1.33)	0.67	(1.53)
Fearful - Fearless	1.36	(1.24)	1.80	(1.23)	0.83	(1.23)	1.11	(1.25)
Anxious – Relaxed	1.05	(0.98)	1.31	(1.39)	0.61	(1.35)	0.58	(1.58)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	0.92	(1.62)	0.52	(1.58)	0.25	(1.39)	0.52	(1.35)
Fearful - Fearless	1.17	(1.40)	0.84	(1.57)	0.22	(1.34)	0.58	(1.30)
Anxious – Relaxed	0.81	(1.39)	0.34	(1.68)	-0.03	(1.30)	0.47	(1.57)

Note: Negative Scores reflect greater nervousness, fearfulness and anxiety, whereas positive scores reflect the opposite.

The ARQ data was analysed in three separate 2 X 2 X 2 ANOVAs, with trait anxiety (LTA vs. HTA), shock condition (shock safe vs. shock threat) and presentation order (unmasked first vs. masked first) as the between groups factors and the nervousness, fearfulness and anxiousness dimensions as the dependent variables. On the nervousness dimension, a main effect of shock condition emerged, such that, those in the shock threat group (M = .50; SE = .18) reporting more nervousness than those in the shock safe group (M

= 1.01; *SE* = .18), *F* (1, 120) = 4.09, *MSE* = 2.03, *p* = .048, η_p^2 = .032. There were no other main effects or interactions, all *F* < 1 *ns*.

On the fearfulness dimension a main effect of shock condition group was noted reflecting that fact that those in the shock threat group (*M* = .68; *SE* = .17) reported more fearfulness than those in the shock safe group (*M* = 1.29; *SE* = .17), *F* (1, 120) = 6.75, *MSE* = 1.76, *p* = .011, η_p^2 = .053. A main effect of trait anxiety group was also found, reflecting the fact that the HTA participants (*M* = .70; *SE* = .17) reported more fearfulness that than their LTA counterparts (*M* = 1.27; *SE* = .17), *F* (1, 120) = 5.91, *MSE* = 1.76, *p* = .017, η_p^2 = .047. There were no other main effects or interactions, all *F* < 1 *ns*.

On the anxiousness dimension, a main effect of trait anxiety group emerged, *F* (1, 120) = 3.79, *MSE* = 2.01, *p* = .044, η_p^2= .053 with more anxiousness being reported by the HTA group (*M* = .40; *SE* = .18) than the LTA group (*M* = .89; *SE* = .18). A main effect of shock condition was also found, with the shock threat group *(M* = .41; *SE* = .18) reporting more anxiousness compared to the shock safe group (*M* = .88; *SE* = .18), *F* (1, 120) = 3.55, *MSE* = 2.01, *p* = .049, η_p^2 = .029. There were no other main effects or interactions, all *F* < 1 *ns*.

Validity of masking procedure in preventing awareness. The SOA of the masked stimuli was set to 15 msec for all participants. The rationale for setting this duration was to avoid possible priming effects on the masked trials (see Chapter 2 for review). The percentage of correct responses between all eight experimental groups is shown in Table 5.3. The groups were comparable on performance across the final awareness check trials. Performance of these groups as a whole (*M* = 23.44; *SD* = 3.69) did not differ from that expected by chance (24; i.e., 50 %), z = .15 *ns*. The data suggests that participants were unaware of the stimuli in the masked condition.

Table 5.3

Study 2.1. Means and Standard Deviations of Correct Responses (%) on the Final Awareness Check Trial in the HTA and LTA Group Performing Under Shock Safe and Shock Threat Conditions in the Unmasked First and Masked First Blocks.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Correct Responses (%)	51.17	(3.23)	49.22	(4.16)	51.69	(16.58)	47.52	(5.8)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Correct Responses (%)	47.92	(6.85)	47.53	(5.06)	46.35	(6.52)	49.22	(5.80)

Data Reduction

Prior to statistical analysis, the colour naming reaction time data was reduced in the following stages: (a) microphone failures (1.33%); (b) colour naming errors (0.71%); (c) responses less than 300 msec or more than 3000 msec (0.41%); and (d) trials more than 2 SD from each cell mean (4.55% of trials).

Error data. The percentage of errors in each experimental condition is shown in Table 5.4. Colour naming error data was analysed using a 3 X 2 X 2 X 2 mixed design ANCOVA with valence (happy, neutral and threat faces) and exposure mode (masked vs. unmasked) as the within subject variables, and Trait Anxiety group (LTA vs. HTA), shock condition (shock safe vs. shock threat) and presentation order (unmasked first vs. masked first) as the between group variables. The depression scores were entered as a covariate and colour naming errors as the dependent variable. The results revealed no significant main effects or interactions, all $F < 1$ *ns.*

Reaction Time Data

Mean reaction times for each experimental condition were calculated and are shown below in Table 5.5. All reaction time data was analysed using an equivalent design to that used for the error data.

Table 5.4

Study 2.1 Means and Standard Deviations of Error Percentages for Colour Naming Reaction Time Data for Masked and Unmasked Happy, Neutral and Threat Faces for HTA and LTA Participants in the Shock Safe and Shock Threat Groups in Unmasked First and Masked First Presentation Order Conditions.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	0.39	(1.56)	0.39	(1.56)	0.39	(1.56)	0.78	(2.13)
Neutral Faces	0.00	(0.00)	1.17	(2.52)	0.78	(2.13)	1.17	(2.52)
Threat Faces	0.78	(2.13)	0.78	(2.13)	1.17	(2.52)	0.39	(1.56)
Unmasked								
Happy Faces	0.78	(2.13)	0.78	(2.13)	0.00	(0.00)	0.78	(3.13)
Neutral Faces	1.17	(2.52)	1.17	(2.52)	0.00	(0.00)	1.95	(3.76)
Threat Faces	0.39	(1.56)	0.78	(3.13)	0.39	(1.56)	0.00	(0.00)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked 1st		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	0.78	(2.13)	1.17	(3.40)	0.78	(2.13)	0.39	(1.56)
Neutral Faces	1.17	(2.52)	0.78	(2.13)	0.39	(1.56)	1.56	(3.61)
Threat Faces	0.78	(2.13)	0.36	(1.56)	0.78	(2.13)	0.78	(2.13)
Unmasked								
Happy Faces	0.39	(1.56)	0.78	(2.13)	0.78	(2.13)	1.95	(3.76)
Neutral Faces	0.00	(0.00)	1.17	(2.52)	0.39	(1.56)	0.39	(1.56)
Threat Faces	1.17	(2.52)	0.78	(3.13)	0.00	(0.00)	0.39	(1.56)

Table 5.5

Study 2.1 Means and Standard Deviations of Colour Naming Reaction Times in Milliseconds for Masked and Unmasked Happy, Neutral and Threat Faces for the LTA and HTA Participants in the Shock Safe and Threat of Shock Condition for the Unmasked First and Masked First Presentation Order Conditions.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	733	(88)	686	(96)	702	(114)	663	(84)
Neutral Faces	743	(91)	691	(95)	702	(119)	657	(101)
Threat Faces	742	(104)	682	(86)	717	(114)	667	(74)
Unmasked								
Happy Faces	717	(80)	702	(106)	676	(92)	645	(88)
Neutral Faces	711	(82)	693	(94)	679	(88)	660	(85)
Threat Faces	705	(86)	708	(106)	664	(87)	654	(92)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	740	(71)	681	(133)	732	(98)	707	(120)
Neutral Faces	742	(82)	696	(145)	706	(90)	706	(117)
Threat Faces	758	(97)	707	(175)	715	(104)	695	(119)
Unmasked								
Happy Faces	710	(84)	738	(176)	698	(108)	725	(118)
Neutral Faces	721	(79)	720	(122)	693	(90)	725	(106)
Threat Faces	708	(92)	704	(134)	686	(97)	719	(115)

The results revealed a significant Exposure Mode X Presentation Order interaction, F (1, 119) = 28.74, MSE = 82007.90, p < .001, η_p^2 = .195. The interaction is shown below in Figure 5.1. Averaged over valence, trait anxiety and shock condition the interaction reflects the fact that when the unmasked stimuli were presented first, longer colour naming reaction times were associated with the masked stimuli (*M* = 727 msec; *SE* = 13.00) compared to the unmasked stimuli (*M* = 698 msec; *SE* = 12.66), *F* (1, 125) = 28.74, *p* < .001, η_p^2 =.195, whereas when the masked stimuli were presented first, the opposite pattern emerged, with longer reaction times associated with the unmasked stimuli (*M* = 699 msec; *SE* = 12.66) compared to the masked stimuli (*M* = 686 msec; *SE* = 13.00), *F* (1, 125) = 5.83, *p* = 0.017, η_p^2 = .045.

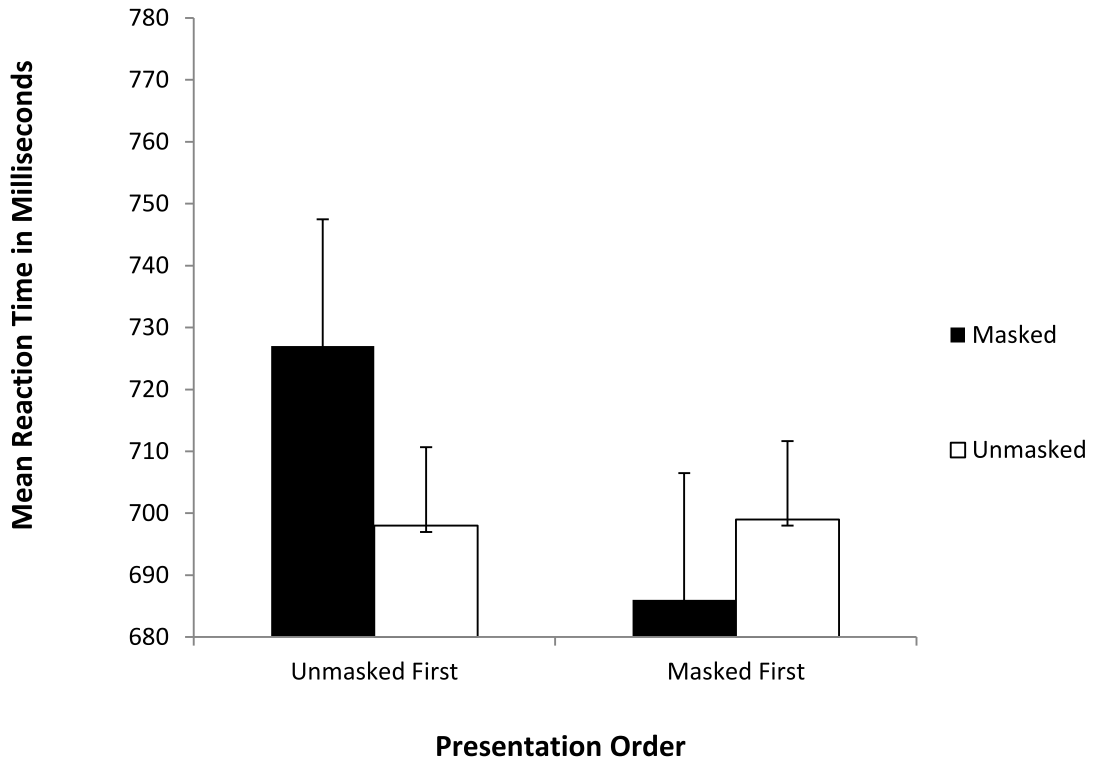

Figure 5.1. Study 2.1. Mean colour naming reaction times in milliseconds for HTA and LTA anxiety groups on the masked and unmasked exposure mode conditions averaged over valence and shock condition. Vertical bars represent standard errors of the mean.

A significant Exposure Mode X Valence X Trait Anxiety Group X Shock Condition interaction also emerged, *F* (2, 238) = 3.29, *MSE* = 1040, *p* = .039, η_p^2 = .027 and is shown below in Figure 5.2. To aid the interpretation of this interaction, the data were analysed separately for masked and unmasked exposure modes. As can be seen in the top left and right panels of Figure 5.2, averaged over presentation order, the data reflect the fact that there was no difference in colour naming latency on the unmasked trials on the basis of trait anxiety or shock condition status, all $F < 1.69$ *ns*. On the masked trials, a significant Valence X Trait Anxiety Group X Shock Condition interaction emerged, F (2, 246) = 3.25, MSE = 1043.94, p = .040, η_p^2 =.026. To decompose this interaction, the data were analysed separately for the LTA and HTA groups. As can be seen in the bottom left panel of Figure 5.3, for the LTA group, colour naming reaction time was not influenced by the valence of the stimuli, shock condition or the interactive effect of both these variables, all $F < 1.09$, $p > .278$ *ns.* For the HTA group however, a marginally significant Valence X Shock Condition interaction emerged, F (2, 60) = 2.97, p = .059, η_p^2 = .090. A series of Bonferoni protected repeated measures t-tests revealed that colour naming latencies for the HTA participants in the shock threat condition were not influenced by the valence of stimuli, all $t < 1.25$, $p > .222$, *ns*, whereas in the shock safe condition, the HTA participants demonstrated significantly longer colour naming latency for masked threat stimuli (M = 732.54 msec) compared to the masked happy stimuli (M = 710 msec), t (31) = 2.08, p = 046. The colour naming latency for neutral faces (M = 719 msec) did not differ from either threat or happy faces, both $t < 1.69$, p >.1 02, *ns*.

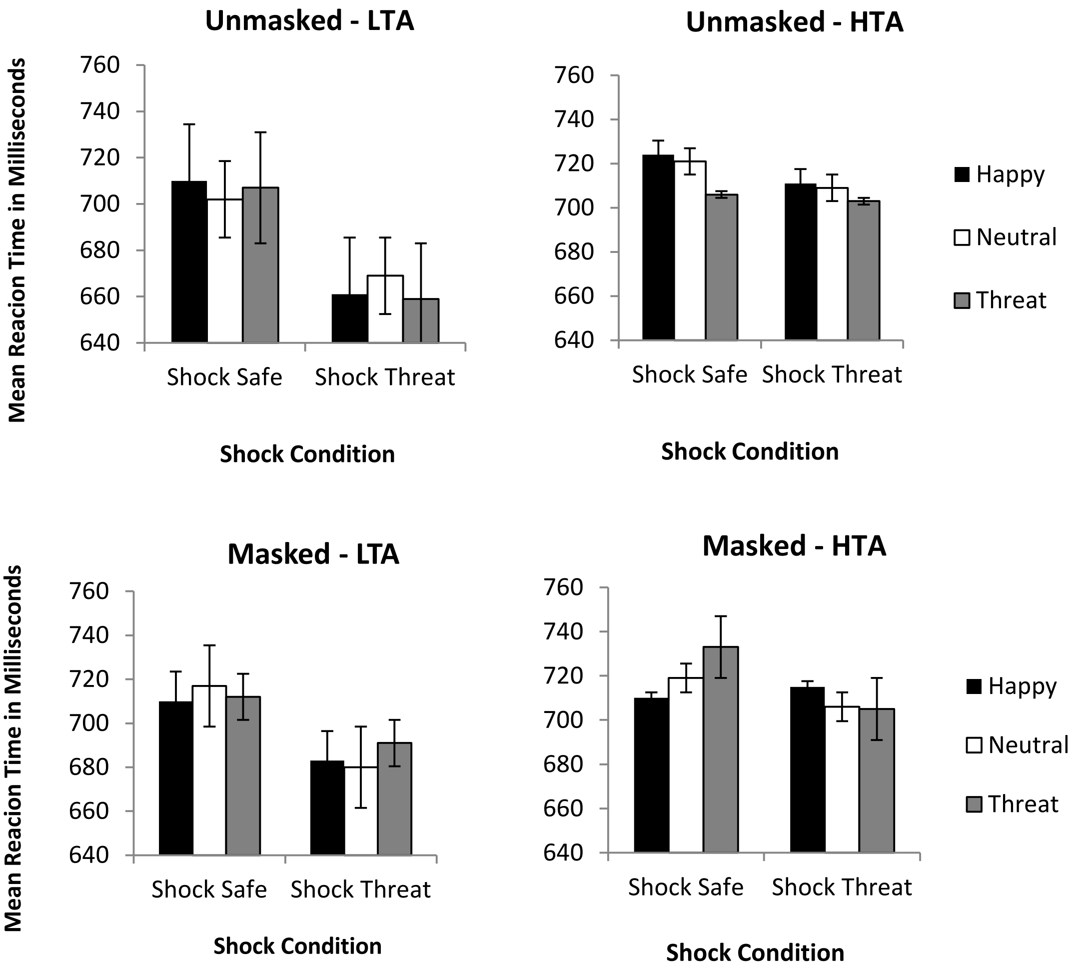

Figure 5. 2. Study 2.1: Mean colour naming reaction times in milliseconds for happy, neutral and threat faces in the LTA and HTA groups on masked and unmasked exposure mode conditions for the shock safe and threat of shock groups averaged over presentation order. Vertical bars represent standard errors of the mean.

Discussion

The purpose of the present study was (1) to investigate the automaticity of selective attention for masked and unmasked pictorial threat in non-clinical, high trait anxious (HTA) and low trait anxious (LTA) participants and to investigate the priming hypothesis proposed by Öhman (1993). The central aims of the proposed study were: (1) to investigate whether the presentation of schematic faces would produce differential patterns in attentional allocation to threat faces between the HTA and LTA participants compared to the attentional bias for threat words observed across all participants in Study 1; (2) to assess the role of awareness in moderating these effects; and (3) to investigate whether priming is a precursor for threat processing at pre-attentive levels by presenting masked and unmasked trials blocked on exposure mode.

Following Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) the following predictions were made: (1) If priming is not needed to elicit preconscious threat processing effects, then in line with Clark and Beck (2010) it was predicted that HTA relative to LTA participants would be slower to colour name masked and unmasked threat faces relative to non-threat faces irrespective of whether masked or unmasked trials were presented first, but only while performing under the threat of shock; (2) If priming is needed to elicit masked threat processing effects, then in line with Öhman (1993) it was predicted that HTA relative to LTA participants would be slower to colour name masked threat faces relative to masked neutral faces but only while performing under the threat of shock and only when unmasked trials were presented before the masked trials; and (3) if the schematic threat faces do carry more threat value than threat words then following Mogg and Bradley (1998) and Öhman and Mineka (2001), it was predicted that HTA and LTA participants would be slower to colour name masked and unmasked threat faces relative to neutral or happy faces but only while performing under the threat of shock and only when unmasked trials were presented before the masked trials.

The data from the present study partially supported the first prediction, such that HTA relative to LTA participants were slower to colour name masked threat faces relative to happy faces, irrespective of whether they were presented with a block of masked trials first or unmasked trials first. However, these processing biases were only observed under shock safe conditions and there was no evidence for selective attention to threat on unmasked trials. These data therefore suggest that HTA participants demonstrate an attentional bias to threat for stimuli that are presented outside of conscious awareness but this threat processing bias is not evidenced when conscious access to threat items is permitted. The data for the masked trials was consistent with results reported by Mogg and Bradley (1999a, Experiment 1 & Experiment 3), who also found vigilance for masked threat faces relative to masked happy faces. In opposition to Öhman's (1993) priming hypothesis, the present data revealed that priming was not a precursor for eliciting preconscious processing of threat. Therefore, these data may suggest that schematic faces hold some biologically prepared relevance.

Further, in HTA shock safe participants, on the masked trials, longer colour naming reaction times were associated with the threat faces relative to the happy faces, whereas the reaction times to the neutral faces did not differ from either the threat or happy faces. The failure to detect significant differences between the threat and neutral faces in HTA participants on the emotional Stroop task is congruent with others (e.g., Putman et al., 2004; van Honk et al., 2001). It is therefore possible that participants engaged in a comparison based evaluative process between threat and happy faces and threat and neutral faces and that this comparison may play an important role in the recruiting of selective attention for pictorial stimuli. Given that the findings of the current study revealed evidence for selective processing of threat faces relative to happy faces in anxious participants, this may suggest that selective attention in anxious individuals is based on valence rather than emotionality. These date provide support for the models of Clark and Beck (2010), Mogg and Bradley (1998) , Öhman (1993) and Öhman and Mineka (2001), which propose that anxiety is characterized by an attentional bias to threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness.

In the current study, on the unmasked trials, there was no evidence to suggest that the threatening faces were processed differently from the happy or neutral faces in either the HTA or LTA participants. These findings are in accord with Putman et al. (2004) and van Honk et al. (2001) who also failed to find selective processing of threat faces on the emotional Stroop colour naming task. These finding are incongruent with the theoretical models described in Chapter 1, and in comparison the threat processing biases observed on the masked trials.

The findings revealed that attentional biases to threat were only observed in the HTA participants on masked trials when performing under shock safe conditions, with no differences in attentional allocation observed in the shock threat conditions. Others, employing verbal stimuli on this task, found masked effects under stress conditions (e.g., Edwards et al., 2010b). In comparing the finding of these studies, it may be that pictorial threat may carry greater threat value than verbal threat, and therefore HTA participants may not rely on increased state anxiety to moderate selective processing of pictorial threat. This speculation is however problematic for reconciling attention patterns when anxiety is high. These finding are at odds with Öhman and Mineka's (2001) theory that attentional biases to threat are moderated by current arousal. Further, if it is accepted that threat faces do carry more threat value than threat words, then these findings are also inconsistent with Mogg and Bradley's (1998) model, which proposes that as the value of threat increases the attentional biases should be observed in both HTA and LTA individuals irrespective of current levels of stress.

Summary

The findings of Study 2.1 suggest that when stimuli are blocked on exposure, HTA individuals selectively attend to schematic pictures of threatening faces relative to happy faces but only when stimuli are presented masked and only under conditions of low arousal irrespective of blocking. These findings offer mixed support for the models under investigation. First, these finding support the theoretical position of Clark and Beck (2010) who place emphasis on trait anxiety in moderating attentional biases to threat in anxiety. However, these findings are at odds with Mogg and Bradley's (1998) theoretical position, proposing that increases in state anxiety and stimulus threat value should be associated with selective attention for threat irrespective of trait anxiety. These findings are also inconsistent with Öhman and Mineka's (2001) theoretical view which places emphasis on higher state anxiety in moderating these effects. In the present study, selective processing of threat was only observed in the shock safe condition. The findings are also at odds with Öhman's (1993) theoretical view proposing the need for priming of the mechanisms responsible for eliciting threat processing at preconscious levels. In the present study, selective processing of threat was observed on masked trials irrespective of whether masked or unmasked trials were presented first. These data suggest that anxiety is characterized by an attentional bias to pictorial threat, and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness within the attentional system, but is restricted to masked stimuli and under conditions of low stress.

Study 2.2

Individual Differences in Attention for Intermixed Masked and Unmasked Emotionally Toned Faces in Anxiety with and without the Threat of Shock on the Emotional Stroop Task.

Aim of Study

The findings of Study 1 revealed evidence for attentional biases for verbal threat across all anxiety groups, irrespective of state anxiety manipulation, exposure mode and exposure mode presentation order. In Study 2.1, HTA participants demonstrated an attentional bias toward masked threat faces irrespective of exposure mode presentation order, but only while performing under shock safe conditions. The aim of the present study was to compare patterns of selective attention for threat faces in HTA and LTA individuals when masked and unmasked trials are intermixed. This comparison was considered important given that in Study 2.1, employing a block exposure design, the findings were puzzling in comparison to others (e.g., Avram et al., 2010; Putman et al., 2004; van Honk et al., 2001) and for theoretical models (Mogg & Bradley, 1998; Öhman & Mineka, 2001). Specifically, Study 2.1 revealed selective processing of pictorial threat in the HTA participants irrespective of exposure mode presentation order but only on masked trials, with unmasked trials not eliciting any differences in processing of threat. Other emotional Stroop studies employing blocked designs with pictorial stimuli failed to produce any significant findings (e.g., Putman et al., 2004; van Honk et al., 2001) while others employing unmasked pictorial stimuli on this task found evidence for threat processing biases on unmasked trials (e.g., Avram et al., 2010). The current study employed a intermixed sequence of masked and unmasked trials.

Hypothesis

In In accord with Clark and Beck (2010), Mogg and Bradley (1998), and Öhman and Mineka (2001), several specific predictions were made. First, in line with Clark and Beck (2010) and Öhman and Mineka (2001) it was predicted that HTA relative to LTA participants would be slower to colour name masked and unmasked threat faces relative to non-threat faces but only while performing under the threat of shock. However, if the schematic threat faces do carry more threat valued than threat words then in line with Mogg and Bradley (1998) and Öhman and Mineka (2001) it was predicted that HTA and LTA participants would be slower to colour name masked and unmasked threat faces relative to neutral or happy faces but only while performing under the threat of shock.

Method

Participants

A sample of 120 Bond University students, staff and Gold Coast community volunteers participated in this study. Chapter 3 details the incentives for participating and screening criteria. Of those who met initial screening criteria, 6 participants were excluded due to high depression scores and 12 participants were excluded due to a high social desirability score. They were thanked, given their incentive, a handout detailing the nature of the study, and released. Of those included in the experimental phase the data from a further 3 participants was excluded from analysis, one disclosed being over 65 years old, one reported a heart condition and another reported being colour blind, after initially withholding this information. Data from a further 35 participants was excluded on the basis of their performance on the final awareness check.

Sixty-four participants, 18 male and 46 female, aged 18 years to 65 years (*M* = 32.41 years; *SD* = 14.68) made up the final sample. Participants were allocated to a trait anxiety group (32 LTA; 32 HTA) following the same criteria used in Study 1. That is, those who scored 36 and below on the STAI-T were assigned to the LTA group and those who scored 37 and above were assigned to the HTA group. Based on their order of arrival at the laboratory, half of the participants within each trait anxiety group were randomly allocated to either the shock safe or shock threat condition.

Apparatus

Details for the Experimental Hardware, Software and Electric Shock stimulus used in Study 2.2 are provided in Chapter 3.

Materials

Face stimuli. Details on the face, non-face and mask stimuli used in the initial threshold setting trials, practice trials, colour naming trials and final awareness check trials in Study 2.2 are provided in Chapter 3.

Psychometric Measures

All participants completed the STAI-T, STAI-S, Depression scale of the DASS, MCSDS and ARQ. Chapter 3 details each questionnaire including psychometric properties, scoring and inclusion/exclusion criteria.

Design

A 3 X 2 X 2 X 2 mixed design was used for the study. The within subjects factors were valence (happy face, neutral face, threat face) and exposure mode (unmasked vs. masked). The between subjects factors were trait anxiety group (HTA vs. LTA) and shock condition (shock threat vs. shock safe). The dependent variables were colour naming reaction times and colour naming errors.

Procedure

All participants provided voluntary informed consent and answered eligibility related questions before completing the questionnaires. They were then allocated to conditions and underwent the initial stimulus onset asynchrony (SOA) setting followed by the shock intensity setting (if in the shock threat group), practice trials and experimental procedure and the final awareness check trials.

SOA threshold setting. Each participant was presented with a series of face –non-face decision trials in which a face or a scrambled face (non-face) was briefly presented on the screen and quickly replaced by one of four pattern masks. Each block consisted of 12 trials with 6 faces and 6 non-faces randomly presented within each block. Participants were instructed to indicate whether a face or a non-face preceded the onset of the mask by pressing a left arrow on their keyboard for face and the right arrow for non-face. If participants were unsure of the stimulus they were instructed to guess. A potential for a response bias was controlled by reminding participants who reported seeing all faces or all non-faces of the experimental parameters. Participants were made familiar with the face/non-face exemplars via a printout prior to this task.

The targets were presented in a quasi-randomised order governed by the parameter that items of the same status (i.e., face vs. scrambled-face) were not presented on more than two consecutive trials. Within a block of 12 trials, each stimulus was presented twice in each colour. Each colour was presented three times in a block of 12 trials and each colour was assigned to each stimulus twice in a block of 48 trials. Each mask was assigned to each stimulus twice across 48 trials and each mask was presented three times in each block of 12 trials. Each mask was not assigned more than once to the same face within a block of 12 trials. That is, each mask was assigned to each face across every two blocks of 12 trials.

Similarly, each mask was assigned to each of the scrambled-faces once every four blocks of 12 trials, and the same mask was not presented on more than two consecutive trials.

On each trial, participants were presented with a row of three white crosses in the centre of the screen for one second. These served as a fixation point for the stimuli. The screen was then blanked for 250 msec and replaced by either a red, green blue or yellow face or a non-face in the location formerly occupied by the crosses. A mask of the same colour replaced the stimuli.

In the first block, the SOA between the face/non-face and the mask started at 80 msec and was systematically reduced to 60, 40, 35, 30, 25, 20, 15, 10, and 5 msec, if a score of 6 or more correct classifications was achieved. Participants were informed of their performance at the end of each block. On a block in which fewer than 6 correct responses were achieved, participants were presented with a block of 24 trials at the exposure duration to ensure that they were genuinely unaware of the stimuli. Participants were informed that within a block of 24 trials, 12 trials would be faces and 12 non-faces. When fewer than 12 correct responses were achieved the SOA was set and applied to the practice and experimental trials. If 12 or more correct responses were achieved, the SOA was reduced to the next level and a block of 12 trials was presented. This procedure continued until the participant achieved fewer than 12 of 24 correct identifications. At this stage the corresponding SOA was applied for the remainder of the experiment.

Shock intensity setting Participants in the shock threat condition undertook the shock intensity setting procedure which was set individually for each participant following the procedure reported for Study 1.

Practice trials. The experimental procedures relating to participants' task demands and instructions, recording and scoring of responses and stimuli counterbalancing on the practice trials in Study 2.2 were governed by the same parameters as those employed in Study 2.1 (See Study 2.1 for details).

Experimental trials. The procedure and stimuli on the colour naming trials in Study 2.2 were the same as in Study 2.1 with the exception that the current study employed individually set SOAs between the target and that mask, which were determined during the SOA threshold setting procedure, and the unmasked and masked trials were presented intermixed over the four blocks of 24 trials.

Stimulus presentation was counterbalanced and governed by the following parameters. No more than two consecutive trials of the same face type, colour and mask were presented in a block of 24 trials. In a block of 24 trials, each face type was presented eight times and with each colour twice. Each mask was presented three times in a block of 24 trials and with each faces type twice and always appeared in the same colour in the block. To control for potential differences in valence between the masks, each was presented in only one colour for each participant, but the assignment of colours to masks was fully counterbalanced across 64 participants. Across a block of 24 trials, each colour appeared six times and twice with each face type, and three times with each mask across two blocks of 48 trials. For masked trials, the target and its mask always appeared in the same colour. Each exposure mode occurred an equal number of times within each block of 24 trials.

Awareness check trials. Following the completion of the four blocks of experimental colour naming trials, each participant completed a block of 48 awareness check trials to ensure that they remained unaware of the content of the masked stimuli. The procedural and stimulus counterbalancing details were the same as for Study 2.1 with the exception that in the current study the SOAs between the target and the mask were determined during the SOA threshold setting procedure. Only data from those participants who scored 24 or fewer correct responses was retained because they were considered to have remained unaware of the masked stimuli during the experimental colour naming trials. At the conclusion of the task, all participants were thanked, debriefed and released.

Results

Manipulation Checks

As with the previous studies in the present thesis, separate manipulations checks were conducted to confirm that groups were differentiated on trait anxiety and to validate the experimental manipulations prior to statistical analysis of the colour naming reaction time data.

Validity of trait anxiety group status. In line with Study 2.1, validation was sought that the HTA and LTA participants significantly differed on self-reported trait anxiety. STAI-T scores were subjected to a 2 X 2 analysis of variance (ANOVA) with trait anxiety group (HTA vs. LTA) and shock condition group (shock safe vs. shock threat) as the between subject variables and STAI-T scores as the dependent variable. The results revealed a significant main effect of Trait Anxiety Group, F (1, 60) = 129.74, MSE = 21.96, p < .001, η_p^2 = .684, with the LTA group (M = 31.03; SE = 0.83) reporting lower trait anxiety than the HTA group (M = 44.38; SE = 0.83). There were no other main effects or interactions, all F < 2.15, p > .148 *ns.*

To assess for differences in self-reported state anxiety, depression, social desirability and age the data were subject to 4 separate 2 X 2 ANOVAs with trait anxiety group and shock condition group as the between subject variables and STAI-S, DASS-D, MCSDS scores and age of participants as the dependent variables. On the STAI-S measure, the results revealed a significant main effect of trait anxiety group, F (1, 60) = 13.58, MSE = 51.23, p < .001, η_p^2 =. 185, with the LTA group (M = 29.38; SE = 1.27) reporting lower state anxiety than the HTA group (*M* = 35.97; *SE* = 1.27). There were no other main effects or interactions, all $F < 1.37$, $p > .247$ *ns*. An analysis of the Depression scale on the DASS revealed a significant main effect of Trait Anxiety, $F(1, 60) = 13.29$, $MSE = 18.97$, $p = .001$, $\eta_p^2 = .181$, with the LTA participants (*M* = 2.75; *SE* = .77) reporting lower depression than their HTA counterparts (*M* = 6.72; *SE* = .77). There were no other main effects or interactions, all $F < 2.31$, $p > .133$ *ns*. Further analysis revealed that MCSDS scores and age of participants were equally distributed among the groups, all $F < 3.23$, $p > .078$ *ns*. A chi square analysis revealed that gender was proportionately distributed among the anxiety groups, $\chi^2(3) = 1.55$, $p = .672$ *ns*. See Table 5.6 for means and standard deviations of questionnaire and age variables.

Table 5.6

Study 2.2 Means and Standard Variations for Questionnaire and Age Variables

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	33.94	(15.69)	30.38	(14.28)	34.81	(16.2)	30.5	(13.26)
STAI-T	30.87	(3.58)	31.19	(3.71)	42.81	(4.86)	45.94	(6.14)
STAI-S	28.69	(7.78)	30.06	(5.01)	37.37	(9.38)	34.56	(5.60)
DASS-D	2.00	(2.42)	3.50	(4.01)	5.81	(4.36)	7.62	(5.85)
MCSDS	6.63	(1.93)	6.00	(1.86)	7.25	(1.57)	6.94	(1.57)

Validity of state anxiety manipulation. To verify that shock intensity was comparable between groups, the data for the HTA and LTA participants in the shock threat condition was analysed. The shock intensity for the LTA group (*M* = 16.88 V; *SD*= 19.58) and the HTA group (*M* = 20.31 V; *SD* = 23.07), was comparable, $t < 1$ *ns*. The effectiveness of the threat of shock as an anxiety induction method was validated by examining the HTA and LTA participants' responses on the ARQ with and without the threat of shock. A single index on each dimension of the ARQ was obtained by averaging nervousness, fearfulness and anxiousness responses over blocks of trials. Means and standard deviations of each scale on the ARQ for HTA and LTA groups under the threat of shock and in the shock safe condition are reported in Table 5.7.

Table 5.7

Study 2.2. Means and Standard Deviations of Responses for HTA and LTA Participants on Three Dimensions of the Arousal Rating Questionnaire Under Shock Safe and Shock Treat Conditions.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	1.70	(1.18)	0.78	(1.50)	1.47	(1.15)	-0.09	(1.10)
Fearful - Fearless	1.89	(1.24)	0.83	(1.50)	1.75	(1.10)	0.14	(1.19)
Anxious – Relaxed	1.67	(1.23)	0.59	(1.58)	1.50	(1.16)	-0.38	(1.10)

Note: Negative Scores reflect greater nervousness, fearfulness and anxiousness, whereas positive scores reflect the opposite.

The ARQ data were analysed by three separate 2 X 2 ANOVAs, with trait anxiety (LTA vs. HTA) and shock condition (shock safe vs. shock threat) as the between groups factors and the nervousness, fearfulness and anxiousness dimensions as the dependent variables. For all three dimensions the only significant result to emerge was a main effect of shock condition, with the shock threat group reporting more nervousness (*M* =.34; *SE* =.22), F (1, 60) = 16.00, *MSE* = 1.54, p <.001, $\eta_p^{2.}$ = .200, fearfulness (*M* = .48; *SE* = .22), F (1, 60) = 17.88, *MSE* = 1.60, p <.001, $\eta_p^{2.}$=.230, and anxiousness (*M* = .11; *SE* = .23), F (1, 60) = 20.89, *MSE* = 1.67, p <.001, $\eta_p^{2.}$ = .258, than their shock safe counterparts (*M* = 1.59, *SE* = .22; *M* = 1.82; *SE* = .22; *M* = 1.59; *SE* = .23, respectively). There were no other main effects or interactions, all F < 1 *ns*.

Validity of masking procedure in preventing awareness. To validate that the SOA on masked trials was comparable between groups, the data were subject to a 2 X 2 ANOVA with anxiety group (LTA vs. HTA) and shock condition (shock safe vs. shock threat) as the factors and SOA as the dependent variable. The results revealed comparable SOA between all groups, all $F < 2.07$, $p > .156$ *ns.* See Table 5.2 for SOA means and standard deviation for each group. The data therefore suggest that on the masked trials, all groups performed under comparable exposure durations.

To ensure that participants remained unaware of stimuli on masked trials, the final awareness check data was subject to a 2 X 2 ANOVA with anxiety group and shock condition as the between subject variables and percent of correct responses as the dependent variable. Table 5.8 shows the mean percentage of correct response on the final awareness check trial for all groups. The data revealed a significant main effect of anxiety group, F (1, 60) = 7.26, MSE = 17.27, p = .009, $\eta_p^{2.}$ =.108 with the HTA group making fewer errors than the (M = 48.37 %; SE = .74) LTA group (M = 51.17 %; SE = .74). There were no other significant main effects or interactions, all $F < 2.08$, $p > .155$ *ns*. However, the performance of these groups as a whole (M = 23.89 %; SD = 2.09) did not differ from that expected by chance (24; i.e., 50 %), z = .05 *ns*. The data thus suggest that participants were unaware of the stimuli on the masked trials.

Table 5.8

Study 2.2. Means and Standard Deviations of SOA on Masked Trials and Correct Responses (%) on the Final Awareness Check Trial in the HTA and LTA Group Performing Under Shock Safe and Shock Threat Conditions.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
SOA (msec)	29.09	(26.22)	19.69	(16.28)	16.25	(14.43)	18.44	(19.21)
Correct Responses (%)	50.26	(4.23)	52.08	(3.73)	49.00	(4.17)	47.79	(4.47)

Data Reduction

Prior to statistical analysis, the colour naming data was reduced as follows. Trials containing the following were excluded from analysis: (a) microphone failures (3.92%); (b) colour naming errors (0.75%); (c) responses less than 300 msec or more than 3000 msec (0.54%) after stimulus; and (d) trials more than 2 SD from each individual's cell means (4.56% of trials).

Error data. The percentage of errors in each experimental condition is shown in Table 5.9. The error data were analysed using a 3 X 2 X 2 X 2 mixed design ANCOVA with valence (happy, neutral and threat faces) and exposure mode (masked vs. unmasked) as the within subject variables, trait anxiety group (LTA vs. HTA) and shock condition (shock safe vs. shock threat) as the between group variables, and depression scores as the covariate. The only significant finding to emerge was a main effect of trait anxiety, with fewer colour naming errors occurring in the HTA group (M = 0.39%; SD = 0.20) than the LTA group (M = 1.07%; SD = .20), F (1, 59) = 4.95, MSE = 7.61, p = .030, η_p^2 =. 077. All other main effects and interactions were non-significant, all F < 2.81 *ns.*

Table 5.9

Study 2.2 Means and Standard Deviations of Error Percentages in Colour Naming Masked and Unmasked Happy, Neutral and Threat Faces for High Trait Anxious and Low Trait Anxious Participants in The Shock Safe and Shock Threat Conditions.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	1.17	(2.51)	0.78	(2.13)	0.00	(0.00)	0.39	(1.56)
Neutral Faces	0.78	(2.13)	0.39	(1.56)	0.78	(2.13)	0.00	(0.00)
Threat Faces	2.34	(5.04)	0.01	(0.02)	0.00	(0.00)	0.77	(3.06)
Unmasked								
Happy Faces	0.39	(1.56)	1.55	(3.56)	0.00	(0.00)	0.39	(1.56)
Neutral Faces	1.55	(3.56)	1.56	(2.80)	1.17	(2.52)	0.39	(1.56)
Threat Faces	1.17	(2.52)	1.17	(2.52)	0.39	(1.56)	0.39	(1.56)

Reaction Time Data

Mean reaction times for each experimental condition were calculated and are shown in Table 5.10. The reaction time data were analysed using an equivalent design to the error data.

Table 5.10

Study 2.2. Means and Standard Deviations of Colour Naming Reaction Times in Milliseconds for Masked and Unmasked Happy, Neutral and Threat Faces for LTA and HTA Participants in the Shock Safe and Threat of Shock Condition.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	639	(137)	630	(106)	618	(84)	624	(102)
Neutral Faces	640	(126)	646	(89)	628	(85)	637	(104)
Threat Faces	643	(146)	633	(101)	622	(86)	640	(94)
Unmasked								
Happy Faces	618	(108)	631	(108)	615	(84)	632	(98)
Neutral Faces	602	(103)	624	(101)	613	(104)	620	(90)
Threat Faces	605	(119)	606	(101)	609	(90)	617	(94)

The only significant result to emerge was a Trait Anxiety X Exposure Mode Interaction, F (1, 59) = 4.07, MSE =1567.18, p = .048, η_p^2 = .64. The interaction is shown below in Figure 5.3. Averaged over valence and shock condition, the interaction reflects the fact that there was no significant difference in colour naming for masked (M = 635 msec; SE = 19.41) and unmasked (M = 627 msec; SE = 17.73) faces in the HTA group, F (1, 61) = 2.06, p = .156, η_p^2=.033, whereas the LTA group took longer to colour name masked (M = 635 msec; SE = 19.09) relative to unmasked (M = 605 msec; SE = 17.73) faces, F (1, 61) = 18.34, p <.001, η_p^2=.231. There were no other significant main effects or interactions, all F < 3.86, p > .054 *ns*.

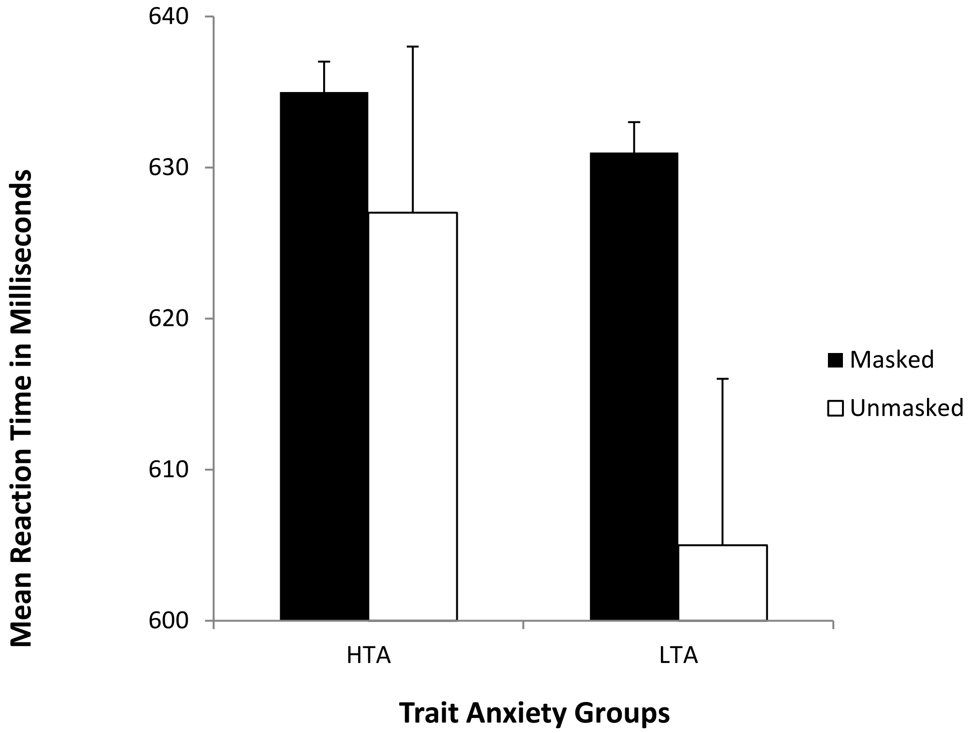

Figure 5.3. Study 2.2. Mean colour naming reaction times in milliseconds for HTA and LTA anxiety groups on the masked and unmasked exposure mode conditions averaged over valence and shock condition. Vertical bars represent standard errors of the mean.

Discussion

The present study was designed to compare patterns of selective attention for threat faces in HTA and LTA individuals when masked and unmasked trials were intermixed. Following Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001) several specific predictions were made. First, in line with Beck and Clark (2010) and Öhman and Mineka (2001) it was predicted that HTA relative to LTA participants would be slower to colour name masked and unmasked threat faces relative to non-threat faces but only while performing under the threat of shock. However, if the schematic threat faces do carry more threat valued than threat words, then in line with Mogg and Bradley (1998) and Öhman and Mineka (2001) it was predicted that HTA and LTA participants would be slower to colour name masked and unmasked threat faces relative to neutral or happy faces but only when performing under the threat of shock.

The data from the present study failed to provide support for these predictions. The current data did not reveal any significant masked or unmasked threat processing biases in either HTA or LTA participants irrespective of shock condition and presentation order. These findings suggest that on the emotional Stroop colour naming task, when schematic faces are used as stimuli and masked and unmasked trials are intermixed, anxiety was not characterized by an automatic attentional bias toward threat. Therefore, when taken together, the data from Study 2.1 and Study 2.2 suggest that attentional biases for pictorial threat operate differently when exposure modes are blocked versus when they are presented in an intermixed order. The absence of significant findings in the current study was consistent with those of van Honk et al. (2001) and Putman (2004).

The present findings were incompatible with others employing the dot probe paradigms. For example, selective processing of pictorial threat was observed in both HTA (e.g., Mogg, Falla & Hamilton, 1998) and LTA participants (e.g., Bradley, Wilson & MacLeod, 2003**)**. The discrepant findings between the current study and those mentioned above could be attributed to a number of factors. First, the above mentioned studies employed a paradigm that was not capable of assessing for the involuntary aspect of the automaticity hypothesis (see Chapter 2). Therefore, it is possible that when masked and unmasked pictorial stimuli are presented intermixed, attentional biases for threat in anxious individuals do not occur counter to intent. Second, the above studies employed pictures of human faces as stimuli, whereas the current study employed schematic representations of human faces. It may be that schematic representations of human faces do not carry as much threat value as photographs of human faces depicting angry expressions. This possibility can be argued on the basis of Mogg et al. (2007) and Wilson and MacLeod's (2003) studies, which varied the degree of threat stimuli and found that anxiety was associated with the intensity of threat. That is, more anger/threat was needed for vigilance to threat to occur in both HTA (Mogg et al. 2007) and LTA individuals (Wilson & MacLeod, 2003). Third, the current study failed to find evidence for the "without awareness" component of the automaticity hypothesis. These findings are discordant with those observed by Lee and Knight (2009) who presented participants with an intermixed sequence of masked and unmasked trials on a dot probe task and found evidence for vigilance to threat at pre-attentive levels.

The findings of the present study did not support the first prediction made by the theoretical positions described in Chapter 1. That is, the data did not provide evidence for selective processing of pictorial threat in anxiety. Second, the data did not provide evidence for the automaticity hypothesis proposed by all models described in Chapter 1. That is, the data failed to produce evidence for the involuntary and without awareness component of selective attention to threat in anxiety. When taken together, it would appear that when masked and unmasked schematic faces are presented intermixed there is no evidence of selective processing of threat as a function of anxiety, at least under the conditions reported here. These findings may also suggest that although selective processing for pictorial threat was observed on dot probe studies when masked and unmasked stimuli were intermixed, these biases may not operate involuntarily within the attentional system. Further these findings suggest that conscious awareness of threat may override the mechanisms responsible for detecting threat at preconscious levels.

Chapter Summary

The findings of Study 2.1 suggest that HTA individuals selectively attend to schematic pictures of threatening faces relative to happy faces but only when they are unaware of the semantic content of the stimuli and only under conditions of low arousal. The findings of Study 2.2 suggest that when conscious awareness to threat is primed these effects disappear. These findings offer mixed support for the theoretical positions described in Chapter 1. First, the findings of Study 2.1 support the theoretical position of Clark and Beck (2010) who place emphasis on trait anxiety in moderating attentional biases to threat in anxiety. These data are inconsistent with Mogg and Bradley’s (1998) theoretical position proposing that if the value of threat increases both HTA and LTA individuals should selectively attend to threat stimuli. These finding are also inconsistent with Öhman and Mineka’s (2001) theoretical view which places emphasis on state anxiety in moderating these effects. Of central importance, these finding are at odds with Öhman (1993) theoretical view proposing that priming is a precursor for eliciting pre-attentive processing of threat.

In Summary, Studies 1, 2.1 and 2.1 employed the emotional Stoop colour naming task. Despite the effectiveness of this task at investigating attentional patterns in anxiety (see Chapter 2), from an ecological perspective, it is unlikely that a person will be asked to ignore a threat stimulus when looking directly at it. Alternatively, the flanker task controls for this limitation by spatially separating the to-be-attended to and the to-be-ignored stimuli (see Chapter 2). This task was employed across the remaining two studies.

Chapter 6

Automaticity of Attentional Bias to Pictorial Threat in Anxiety: Flanker Task

This chapter continues to examine the central assumptions proposed by the theoretical models described in Chapter 1 (Clark & Beck, 2010; Mogg & Bradley, 1998 and Öhman & Mineka, 2001). The central purpose of this chapter was to investigate the role of awareness in processing of pictorial threat on a more ecologically valid Flanker task, where the to-be-attended (probes) and the to-be-ignored (faces) stimuli are spatially separated. Although the emotional Stroop is a widely used paradigm for the purpose of investigating attentional patterns in anxiety (see Chapter 2), from an ecological perspective, it is unlikely that a person will be asked to ignore a threat stimulus when looking directly at it. Alternatively, the Flanker task corrects for this limitation by spatially separating the central task from the threatening information (see Chapter 2).

Flanker Task

The structure of the Flanker task employed here was such that, participants were presented with a fixation cue (+++) in the centre of a computer screen for one second, the screen was blanked for 250 msec and a digit between 2 and 9 (inclusive) was presented in the area formerly occupied by the cue. Each participant used a clearly labelled button box to identify the status of the digit as odd or even, as quickly and accurately as possible. Once the computer software detected the participant's response, the screen was blanked for 250 msec. A pair of schematic faces depicting happy, neutral or threat related expressions appeared on the screen, one below and one above the fixation cue, while simultaneously, a small probe (triangle or square) appeared in the left and right periphery of the screen, approximately 100 mm on either side of the fixation cue. The participants' task was to verbally classify the probe (triangle or square) as quickly and accurately as possible while ignoring the facial expression on the schematic faces.

The digit classification task was employed to ensure that all participants were attending to the centre of the computer screen prior to the onset of the experimental interference task. The Flanker task was employed to overcome a number of limitations associated with the probe detection tasks (e.g, choosing to attend to one side of the computer screen prior to responding to the central task; see Mogg & Bradley, 1998) and other paradigms (see Chapter 2).

Fox (1996, Experiment 1) employed a similar task (see Chapter 2) and found attentional biases for masked threat in the HTA individuals. However, the present methodology differed from that employed by Fox in a number of ways. First, the current study employed happy, neutral and threat schematic faces as stimuli, whereas Fox employed words as stimuli. The importance of conducting the current paradigm with schematic faces is that it is not known whether HTA and LTA participants would demonstrate differential threat processing patterns for schematic faces that are spatially separated from the central task. Second, Fox manipulated state anxiety by testing participants in close proximity to end of term examinations (high state anxiety) but did not include a low state anxiety manipulation for comparison. The current study included the presence of an acute stressor (electric shock), such that half the participants were tested under the threat of shock condition whereas the other half were tested under a shock safe condition. Third, in the current study participants responded to the central task via a vocal response, whereas Fox employed a button press. The vocal response was employed to allow for comparison with colour naming studies reported previously in this thesis. Lastly, Fox required participants to perform a single task focussing on a single task relevant location, whereas the current task required participants to direct their attention between tasks and relevant locations.

Studies 3.1 and 3.2 employed the Flanker task with masked and unmasked happy, neutral and threat schematic faces that were either blocked (Study 3.1) or intermixed (Study 3.2) on exposure mode. The blocked exposure mode consisted of presenting half the participants with two blocks of masked trials followed by two blocks of unmasked trials, whereas the other half received the reverse order. Blocking on exposure was an important variable for assessing Öhman's (1993) priming hypothesis. The intermixed exposures consisted of presenting masked and unmasked trials in a quasi-randomized order. To control for the possibility of incidental priming, on blocked trials, the SOAs between the target and the mask were set at 15 msec in Study 3.1 and were individually determined for each participant in Study 3.2. Awareness checks were carried out following the completion of the experimental trials to ensure that participants did not become aware of masked content during the experiments. As with the studies described in Chapters 4 and 5, the assignment to trait anxiety groups was done on the basis of questionnaire scores, and state anxiety was manipulated through the threat of electric shock. A state anxiety manipulation was included, such that half of the HTA and half of the LTA participants performed under the threat of shock, whereas the other half performed under shock safe conditions. This methodology therefore allowed for a number of investigations: (1) attentional bias for spatially separated pictorial threat faces in HTA and LTA individuals; (2) attention to pictorial threat without volition; (3) attention to pictorial threat without awareness; (4) the relative contribution of state and trait anxiety on selective processing of pictorial threat; and (5) the role of priming in moderating pre-attentive processing of pictorial threat.

Study 3.1

Individual Differences in Attention for Blocked Masked and Unmasked Emotionally Toned Faces in Anxiety with and without the Threat of Shock on the Flanker Task

The findings of the studies reported in the present thesis employing the emotional Stroop task revealed that attentional biases for verbal threat were evidenced across all anxiety groups irrespective of state anxiety manipulation, exposure mode and exposure mode presentation order (Study 1). Further, when schematic faces were used as stimuli and masked and unmasked trials were blocked on exposure, HTA participants demonstrated an attentional bias toward masked threat faces irrespective of exposure mode presentation order, but only while performing under shock safe conditions (Study 2.1); however, when exposure of stimuli was intermixed, the data failed to reveal any significant threat processing effects (Study 2.2).

Aim of Study

The central aims of the present study are to: (1) investigate the role of awareness in selective attention for emotionally toned schematic faces in HTA and LTA participants, and (2) to investigate the role of priming in moderating pre-attentive processing of pictorial threat by presenting masked and unmasked trials blocked on exposure.

Hypotheses

Based on the models of Mogg and Bradley (1998), Clark and Beck (2010) and Öhman and Mineka (2001), the following predictions were made: (1) if priming is needed to elicit masked threat processing effects, then in line with Öhman (1993) it was predicted that HTA relative to LTA participants would be slower to classify probes that were presented with masked threat faces relative to masked neutral faces but only when performing under the threat of shock and only when unmasked trials were presented before the masked trials.

However, if priming is not needed, these patterns of responding will occur irrespective of whether masked or unmasked trials were presented first; (2) If the schematic threat faces do carry more threat value than threat words, then in line with Mogg and Bradley (1998) and Öhman and Mineka (2001) it was predicted that HTA and LTA participants would be slower to classify probes presented with masked and unmasked threat faces relative to neutral or happy faces but only when performing under the threat of shock, and only when unmasked trials were presented before the masked trials.

Method

Participants

A sample of 168 Bond University students, staff and Gold Coast community volunteers participated in the study. Chapter 3 details the incentives for participating and screening criteria. Of those who met the initial screening criteria, three participants were excluded due to high depression scores and 14 due to high social desirability scores. They were thanked, given their incentive, a handout detailing the nature of the study, and released. Of those included in the experimental phase, data from a further two participants were excluded on the basis of age (both were over the age of 65). A further three participants were excluded due to software failure and data from a further 18 participants was excluded on the basis of their performance on the final awareness check.

One hundred and twenty eight participants, 40 male and 88 female, aged 18 years to 65 years (*M* = 30.61 years; *SD* = 14.98) made up the final sample. Participants were allocated to a Trait Anxiety Group (64 LTA, 64 HTA) following the same procedure used in Study 1. That is, those who scored 36 or below on the STAI-T were assigned to the LTA group and those who scored 37 and above were assigned to the HTA group. Based on their order of arrival at the laboratory half of the participants within each anxiety group were randomly allocated to the shock threat (*n* = 64) and shock safe (*n* = 64) conditions, and half the participants in these groups were randomly allocated to the presentation order conditions (masked first, *n* = 64 vs. unmasked first, *n* = 64) which resulted in 16 participants allocated to each experimental group.

Apparatus

Details for the experimental hardware, software and electric shock stimulus used in Study 3.1 are discussed in Chapter 3 above.

Materials

Stimuli. Details of the face, non-face, mask and probe stimuli used in the practice trials, experimental trials and final awareness check trials in Study 3.1 are discussed in Chapter 3 above.

Psychometric Measures

All participants completed the STAI, BDI, MCSDS and ARQ. Chapter 3 provides a description of each questionnaire, including psychometric properties and scoring.

Design

A 3 X 2 X 2 X 2 X 2 mixed design was used for the study. The within subjects factors were valence (happy, neutral, threat face) and exposure mode (masked vs. unmasked). The between subjects factors were trait anxiety group (HTA vs. LTA), shock condition (shock threat vs. shock safe) and presentation order (masked first vs. unmasked first). The dependent variables were probe classification reaction times and probe classification errors.

Procedure

All participants provided voluntary informed consent, answered participant eligibility related questions and completed the questionnaires. Participants within each trait anxiety group were then randomly allocated to a shock threat and shock safe condition, and half of these groups were randomly allocated to a presentation order condition (masked first vs. unmasked first). After allocation to groups, they then underwent shock intensity setting (if in the shock threat group), practice and experimental procedures, and the final awareness check trials. In line with Study 2.1, the SOA was pre-set at 15 msec.

Shock intensity setting. In line with Studies 1, 2.1 and 2.2, after the initial threshold setting procedure was completed, participants who were assigned to the shock threat group underwent a procedure to determine the shock intensity (see Study 1 for procedural details).

Practice trials. Prior to the practice trials, all participants received standard instructions. They were informed that that they would be presented with two tasks: a digit classification task (which was implemented to increase the likelihood that participants were attending to the centre of the screen) and a probe classification task. On the digit classification task, participants were presented with a random series of Odd/Even decision trials in which a digit between 2 and 9 (inclusive) appeared in the centre of the screen. The task required the participants to identify the digit as odd or even as quickly as possible by using a button press, at which time the screen was blanked. Following the digit classification response, participants were presented with a probe classification task. In this task they were required to verbally identify a probe that was presented in the left or right periphery as a triangle or a square as quickly and accurately as possible while ignoring any other stimuli on the screen. All participants underwent a practice block of 24 practice trials to familiarize themselves with the experimental task.

On each trial, participants were presented with a row of three white crosses in the centre of the screen for one second. The crosses served as a fixation point for the digit stimuli. The screen was then blanked for 250 msec at which point it was replaced by a random computer generated odd or even digit, ranging from 2 to 9 (inclusive), in the space formerly occupied by the crosses. Participants were instructed to make a button press in response to classify the digit as even by pressing the left arrow or as odd by pressing the right arrow. The response initiated the offset of the digit, which was immediately followed by a pair of non-faces. In order to control for potential priming effects, six non-faces were used for the practice block. Research (e.g., Miller & Patrick, 2000) has shown that pre-exposing participants to emotional stimuli can potentially reduce the attentional responses over a large number of trials. One non-face appeared above and below the location formerly occupied by the crosses, while either a triangle or a square, appeared on the left or right periphery of the screen. The probes were presented approximately 100 mm on either side of the central fixation point. Once the initial verbal response was recorded the screen was blanked. Once the experimenter coded the responses the next trial was initiated with an average four second inter-trial interval.

All stimuli were counterbalanced and governed by the parameters that no more than two consecutive trials with the same face type were presented in a block of 24 trials. Each non-face was presented eight times in the block of 24 trials, each of the six non-face types presented four times in a block of 24 trials masked and four times in a block of 24 trials unmasked, and each of the four masks was presented three times in a block of 24 trials. On half of the trials the status of the digit was odd whereas for the other half it was even. The status of the digit was randomised but no more than four trials of the same status were presented in succession. On half of the trials the non-face stimuli were presented masked whereas for the other half the non-faces were presented unmasked. The exposure mode was randomly intermixed but no more than two trials of the same exposure mode occurred in succession. Each probe type was presented 6 times to the left of the screen and six times to the right of the screen. The same non-face type, mask, probe type, or probe location were not presented on more than two consecutive trials. The combination of the same non-faces, masks, probe types and probe locations never appeared more than once within the practice block. All stimuli were presented in black colouring.

Half of the stimuli were presented unmasked and half were presented masked. On the unmasked trials, the non-face would remain on the screen until the participants' first vocal response to the probe was recorded by the experimental software. On the masked trials, the non-face was presented at a 15 msec SOA and at the offset, replaced by a pattern mask. The mask remained on the screen until the participant's first vocal response was recorded. The experimenter recorded the participant's response on a separate computer (VDU). Any initial responses that clearly indicated the status of the probe were coded as "correct", and "incorrect" if the initial response was not a clear or accurate classification of the probe (e.g., if the participant stuttered or if the participant reported the wrong probe). Initial responses that failed to be recorded by the experimental software were coded as a "microphone failure". After the experimenter coded the responses the next trial was initiated with an inter-trial interval of approximately four seconds.

Following the practice trials, all participants received a three minute rest period. Those in the shock threat group had the electrode re-attached, and were informed that the computer would deliver between five and seven electric shocks, at random, across the remaining four blocks of experimental trials. Shocks were delivered at the same intensity previously set during the shock intensity setting procedure. In reality, the experimenter delivered the shocks and only five electric shocks were administered for the remainder of the experiment. The first electric shock was administered approximately 15 seconds prior the first experimental probe detection trial. This was done to ensure that participants believed the instructions given to them.

Experimental trials. Prior to the first block of experimental probe classification trials, participants completed the ARQ for the first time. Four blocks of 24 probe classification trials were administered. In line with the practice block, each trial consisted of the same two tasks: (1) digit classification task and (2) probe classification task. The experimental procedure relating to the participants' standard task demands, instructions and recoding and scoring of responses was the same as in the practice trials.

All stimuli were quasi-randomized and governed by the following parameters. The same face type, probe and mask did not appear on more than two consecutive trials. Each face appeared in a block of 24 trials eight times and presented with each probe type four times (probe on left twice and on right twice) and never on more than two consecutive trials. Probe position and type were counterbalanced across the face types within each block of trials but were never presented on more than two trials of the same type in the same combination. On the masked blocks, four masks were employed and the face types and masks were combined to occur an equal number of times. Each probe type was paired with each face an equal number of times in each block. Each mask was presented with each face twice in each block of 24 trials and fully counterbalanced across all trials and participants, such that each mask appeared with each face type, probe and probe location twice across all trials. The status of the items for the digit classification task were counterbalanced with face type, probe type and probe position. On half of the trials within each block, the status of the digit was odd, whereas for the other half it was even. The digit items were randomized and the same item never appeared on more than three consecutive trials.

Consistent with the practice trials, on each trial, participants were presented with the digit classification task and probe classification task. Participants who were assigned to the unmasked first condition received two blocks of 24 unmasked trials first followed by two blocks of masked trials. The masked first group received the opposite presentation order. On the unmasked trials, the face would remain on the screen until the participants' first vocal response to the probe was recorded by the experimental software, at which time the screen was blanked. On the masked trials, the face was presented for 15 msec and replaced by a pattern mask. The mask remained on the screen until the participant's first vocal response was recorded after which the screen was immediately blanked. The experimenter recorded the participant's response on a separate computer (VDU). Any initial responses that clearly indicated the status of the probe were coded as "correct", and "incorrect" if the initial response was not a clear or accurate classification of the probe (e.g., if the participant stuttered or if the participant reported the wrong probe). Initial responses that failed to be recorded by the experimental software were coded as a "microphone failure". After the experimenter coded the responses the next trial was initiated.

Participants in the shock threat group received a second shock immediately after they indicated their final response in the first block. All participants completed the second ARQ during the rest time between Blocks 1 and 2 and those in the shock threat group received their third shock at this time. Block 2 commenced once participants completed the questionnaire. During the rest period between Block 2 and Block 3 participants filled out the third ARQ. Approximately 15 seconds prior to block 3 those in the shock threat group received their fourth electric shock. The fifth and final electric shock was administered immediately following the participant's vocal response for the final trial in Block 3. At this stage participants were anticipating up to two more shocks, when in reality this was the final shock to be administered. Participants completed the final ARQ at this time after which the final block of trials was initiated. Once the final block was completed, those in the shock threat group had the electrode removed.

Awareness check trials. Following the completion of the four blocks of probe classification trials, each participant completed one block of 48 awareness check trials to ensure they were unaware of the masked stimulus content at the end of the experiment. The task demands on the awareness check trials consisted of each participant completing two tasks: a digit classification task and a face-status task. The digit classification task was identical to the one employed in the probe classification task and governed by the same parameters. Following the digit classification response, participants were presented with a face/non-face decision trial in which two faces or two non-faces of the same type were briefly presented above and below the fixation point and were quickly replaced by a pattern mask. The centre-to-centre separation of the facial stimuli was approximately 70 mm. The digit classification trials were governed by the same parameters employed the probe classification task. Participants were first instructed to indicate whether an odd or even digit occurred followed by a face or non-face prior to the onset of the mask by pressing the left arrow on their keyboard for even/face and right arrow for odd/non-face. The SOA between the face type and the mask was set at 15 msec for all participants. If participants were unsure of the stimulus they were instructed to guess. Once the response was made the screen was blanked. The experimental software coded the participant’s responses. Participants were made familiar with the face/non-face exemplars via a printout prior this task.

All odd/even, face/non-face and mask stimuli were counterbalanced within the block of 48 awareness check trials. The same face type (face vs. non-face) never appeared on more than two consecutive trials. Four different masks were presented in the block of 48 trials; the same mask was presented six times but never on more than two consecutive trials, and each mask was only assigned to the same face type twice. On half of the trials the digit was odd and on the other half it was even and the same status never appeared on more than four consecutive trials within the block.

Only data from those participants who scored 27 or fewer correct responses on the awareness check trials was retained because they were considered to have remained unaware of the masked stimuli during the experimental colour naming trials. The data for those who scored 28 or more correct responses was not included in the final analysis. At the conclusion of the task, all participants were thanked, debriefed and released.

Results

Manipulation Checks

Validation was sought to ascertain that groups differed on trait anxiety and to verify the effectiveness of experimental manipulations prior to statistical analysis of the probe classification reaction time data. Table 6.1 presents the data for all person variables.

Validity of trait anxiety group status. To verify that the HTA and LTA participants significantly differed on self-reported trait anxiety and to confirm that trait anxiety did not systematically vary between the other factors, the STAI-T scores were subjected to a 2 X 2 X 2 ANOVA with trait anxiety group (HTA vs. LTA), shock condition (shock safe vs. shock threat) and presentation order (unmasked first vs. masked first) as the between subject variables and STAI-T scores as the dependent variable. The results revealed a significant main effect of trait anxiety group, F (1, 120) = 181.73, MSE = 36.47, p <. 001, η_p^2 = 602, with the LTA group (M = 29.72; SE = .76) reporting lower trait anxiety than the HTA group

(M = 44.11; SE = 0.76). There were no other main effects or interactions, all $F < 2.15$, $p >$ .148 *ns*.

To assess for differences in self-reported state anxiety, depression, social desirability and age the data were subject to four separate 2 X 2 X 2 ANOVAs with trait anxiety group, shock condition and presentation order as the between subject variables and STAI-S, DASS, MCSDS scores and age of participants as the dependent variables. On the STAI-S measure, the results revealed a significant main effect of trait anxiety group, F (1, 120) = 51.46, MSE = 56.67, $p < .001$, $\eta_p^2 = .300$, with the HTA group (M = 38.69; SE = .94) reporting higher state anxiety compared to their LTA counterparts (M = 29.14; SE = .94). There was also a significant main effect of Trait Anxiety Group on the depression measure, F (1, 120) = 58.15, MSE = 19.2, $p < .001$, $\eta_p^2 = .326$, with the HTA participants (M = 8.06.; SE = .55) reporting higher depression compared to their LTA counterparts (M = 2.16; SE = .55). There were no other main effects or interactions, all $F < .86$, $p > .150$ *ns*. There was also a significant main effect of presentation order on the MCSDS measure, F (1, 120) = 5.10, MSE = 3.68, $p = .026$, $\eta_p^2 = .041$, with those in the unmasked first condition (M = 6.83; SE = .24) responding more honestly with fewer socially desirable statements than those in the masked first condition, (M = 6.06; SE = .24). There were no other significant main effects or interactions, all $F < .64$, p >.291 *ns*. The groups were all comparable on age, all $F < 2.10$, all $p > .150$ *ns*. A chi square analysis revealed that gender was proportionately distributed among the trait anxiety groups, χ^2 (1) = .58, $p = .446$ *ns*. However, gender was not proportionately distributed among the shock safe condition (males = 28; females = 36) and the shock threat condition (males = 12; females = 52), χ^2 (1) = 9.31, $p < .05$. See Table 6.1 for means and standard deviations of person variables.

Table 6.1

Study 3.1 Means and Standard Variations for Questionnaire and Age Variables

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	29.56	(15.02)	27.38	(14.81)	29.87	(15.48)	27.88	(12.99)
STAI-T	30.44	(4.50)	27.94	(7.95)	31.25	(3.36)	29.25	(5.53)
STAI-S	28.44	(6.75)	29.69	(5.39)	29.75	(6.12)	28.69	(7.47)
DASS-D	2.38	(2.94)	1.75	(2.41)	2.38	(3.88)	2.13	(3.62)
MCSDS	6.81	(2.17)	6.25	(2.49)	6.5	(1.55)	5.50	(1.51)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	29.25	(14.23)	34.13	(16.99)	36.31	(16.40)	30.50	(14.70)
STAI-T	43.13	(5.26)	45.19	(5.33)	45.88	(4.99)	42.25	(9.24)
STAI-S	36.19	(6.72)	39.44	(7.19)	39.75	(10.12)	39.38	(9.29)
DASS-D	8.63	(4.54)	8.75	(6.28)	8.25	(4.67)	6.63	(5.40)
MCSDS	7.25	(1.39)	6.19	(1.83)	6.75	(1.84)	6.31	(2.27)

Validity of state anxiety manipulation. The data were analysed using an equivalent design to that used in assessing the validity of trait anxiety group status with shock intensity as the dependent variable. There were no significant main effects or interactions, all $F < 1$ *ns*, suggesting that shock intensity was comparable across all conditions. In line with Study 1 and 2.2, the effectiveness of the threat of shock as an anxiety induction method was validated by examining the HTA and LTA participants' responses on the ARQ with and without the threat of shock in the unmasked first and masked first presentation order conditions. As with the previous studies, a single index on each dimension of the ARQ was obtained by averaging nervousness, fearfulness and anxiousness responses over three blocks of trials. Means and standard deviations of each scale on the ARQ for HTA and LTA groups under the threat of shock and in the shock safe condition are reported below in Table 6.2.

Table 6.2

Study 3.1 Means and Standard Deviations of Responses for HTA and LTA Participants on Three Dimensions of the Arousal Rating Questionnaire Under Shock Safe and Shock Threat Conditions for Masked First and Unmasked First Presentation Order Conditions.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	1.55	(1.56)	1.48	(1.18)	0.14	(1.45)	0.31	(0.97)
Fearful - Fearless	1.92	(1.33)	1.77	(1.09)	0.52	(1.03)	0.92	(1.14)
Anxious – Relaxed	1.67	(1.50)	1.25	(1.23)	-0.8	(1.54)	0.53	(1.09)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	0.84	(1.31)	0.63	(1.44)	0.00	(1.38)	-0.25	(1.46)
Fearful - Fearless	0.83	(1.19)	1.09	(1.01)	0.03	(1.43)	-0.23	(1.32)
Anxious – Relaxed	0.61	(1.28)	0.53	(1.37)	-0.48	(1.17)	-0.36	(1.42)

Note: Negative Scores reflect greater nervousness, fearfulness and anxiety, whereas positive scores reflect the opposite.

The ARQ data was analysed using separate 2 X 2 X 2 ANOVAs, with trait anxiety (LTA vs. HTA), shock condition (shock safe vs. shock threat) and presentation order (unmasked first vs. masked first) as the between groups factors and the nervousness, fearfulness and anxiousness dimensions as the dependent variables. The results revealed that the HTA participants reported significantly more nervousness (*M* = .31; *SE* = .17), *F* (1, 120) = 5.58, *MSE* = 1.84, *p* = .020, η_p^2 = .044, fearfulness (*M* = .43; *SE* = 15), *F* (1, 120) = 16.06, *MSE* = 1.45 , *p* < .001, η_p^2 =.118, and anxiousness (*M* = .07; *SE* = 17), *F* (1, 120) = 10.67, *MSE* = 1.78 , *p* = .001, η_p^2 =.082 compared to their LTA counterparts (nervousness, *M* = .87 *SE* = 17; fearfulness, *M* = 1.28 SE = 17; anxiousness, *M* = .84, *SE* = .17). Those in the shock threat condition reported more nervousness (*M* = .05; *SE* = .17), *F* (1, 120) = 20.06, *MSE* = 1.84, *p* < .001, η_p^2 =.143, fearfulness (*M* = .31; *SE* = .17) , *F* (1, 120) = 26.49, *MSE* = 1.45, *p* < .001, η_p^2 = .181, and anxiousness (*M* = -.10; *SE* = .17), *F* (1, 120) = 22.34, *MSE* = 1.78, *p* < .001, η_p^2 = .157 compared to their shock safe counterparts (nervousness, *M* = 1.13, *SE* = 17; fearfulness, *M* = 1.40, *SE* = .17 and anxiousness, *M* = 1.02, *SE* = 17). There were no other main effects or interactions, all *F* < .80, *p* > .193 *ns.* These data suggest that the threat of electric shock was an effective procedure for elevating participants' state anxiety.

Validity of masking procedure in preventing awareness. As in Study 2.1, the SOA between the target and the mask was set at 15 msec for the masked trials. This procedure was employed to control for priming effects and to ensure that participants remained unaware of stimulus content on masked trials. The final awareness check data was subject to a 2 X 2 X 2 ANOVA with trait anxiety group, shock condition and presentation order as the between subject variables and percent of correct responses as the dependent variable. Table 6.3 shows the mean percentage of correct response on the final awareness check trials for all groups. The groups were comparable on the final awareness check trials, *F* < 1 *ns*, and the performance of these groups as a whole (*M* = 23.46; *SD* = 2.88) did not differ from that expected by chance (24; i.e., 50 %), *z* = .19 *ns.* The data suggest that participants were unaware of the stimuli in the masked condition.

Table 6.3.

Study 3.1 Means and Standard Deviations of SOA in Milliseconds and Percentage of Correct Responses on Final Awareness Check Trials For the LTA and HTA Participants in the Shock Safe and Shock Threat Conditions of the Unmasked First and Masked First Trials.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Correct Responses (%)	49.09	(5.84)	46.09	(7.60)	50.78	(5.37)	48.70	(6.22)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Correct Responses (%)	48.57	(5.14)	51.04	(5.74)	48.18	(6.36)	48.57	(5.79)

Data Reduction

Prior to statistical analysis, the colour naming reaction time data was cleaned in four stages. Trials containing the following were excluded from analysis: (a) microphone failures (3.22 %); (b) probe classification errors (2.86 %); (c) responses less than 300 msec or greater than 3000 msec after stimulus (0.47 %) and (d) trials more than 2 SD from each individual's cell means (4.29 % of trials).

Error data. The percentage of errors in each experimental condition is shown in Table 6.4. Probe classification error data were analysed using a 3 X 2 X 2 X 2 X 2 mixed design ANCOVA with valence (happy, neutral and threat faces) and exposure mode (masked vs. unmasked) as the within subject variables and trait anxiety group (LTA vs. HTA), shock condition (shock safe vs. shock threat) and presentation order (unmasked first vs. masked first) as the between group variables. Depression scores were entered as the covariate. The errors in probe classification served as the dependent variable. The results did not reveal any significant main effects or interactions, all $F < 1$ *ns*.

Reaction Time Data

Mean probe classification reaction times for each experimental condition were calculated and are shown below in Table 6.5. All latency data was analysed using an equivalent design to that employed for the error data.

Table 6.4

Study 3.1 Means and Standard Deviations of Error Percentages for Probe Classification Reaction Time Data for Masked and Unmasked Happy, Neutral and Threat Faces for HTA and LTA Participants in the Shock Safe and Shock Threat Groups in the Masked First and Unmasked First Presentation Order.

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	3.16	(3.23)	2.73	(3.20)	5.08	(6.54)	1.95	(2.99)
Neutral Faces	1.95	(3.76)	1.95	(3.76)	2.73	(3.93)	2.73	(4.55)
Threat Faces	2.34	(4.49)	2.34	(3.87)	3.13	(5.10)	3.52	(5.09)
Unmasked								
Happy Faces	3.23	(5.59)	3.91	(5.04)	2.34	(3.87)	1.56	(3.61)
Neutral Faces	2.73	(5.58)	1.95	(3.76)	4.69	(5.82)	3.52	(5.09)
Threat Faces	3.52	(5.09)	0.78	(2.13)	3.52	(5.78)	2.73	(3.93)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	1.56	(3.61)	1.56	(3.61)	3.52	(4.55)	2.73	(6.83)
Neutral Faces	2.34	(3.13)	1.95	(2.99)	2.34	(5.04)	1.17	(2.52)
Threat Faces	3.91	(5.53)	1.17	(2.52)	3.13	(4.56)	1.56	(3.61)
Unmasked								
Happy Faces	3.52	(5.09)	2.34	(3.13)	3.91	(6.80)	3.13	(5.60)
Neutral Faces	2.34	(4.49)	1.56	(2.80)	5.86	(7.76)	2.73	(3.93)
Threat Faces	2.73	(3.93)	1.95	(2.99)	4.69	(5.82)	6.64	(7.73)

Table 6.5

Study 3.1. Means and Standard Deviations of Probe Classification Reaction Times in Milliseconds for Masked and Unmasked Happy, Neutral and Threat Faces for Low Trait Anxious and High Trait Anxious Participants in the Shock Safe and Threat of Shock Condition for Masked First and Unmasked First Presentation Order

	Low Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	861	(132)	799	(74)	857	(141)	841	(75)
Neutral Faces	874	(104)	789	(86)	857	(116)	840	(91)
Threat Faces	863	(123)	791	(78)	860	(138)	834	(67)
Unmasked								
Happy Faces	867	(142)	828	(95)	870	(141)	845	(81)
Neutral Faces	863	(109)	820	(81)	867	(156)	842	(78)
Threat Faces	865	(114)	822	(97)	851	(159)	829	(83)
	High Trait Anxious							
	Shock Safe				Shock Threat			
	Unmasked First		Masked First		Unmasked First		Masked First	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	868	(126)	885	(122)	896	(130)	856	(137)
Neutral Faces	853	(105)	843	(128)	903	(161)	823	(140)
Threat Faces	851	(103)	858	(142)	896	(126)	866	(140)
Unmasked								
Happy Faces	847	(108)	843	(121)	888	(152)	838	(135)
Neutral Faces	850	(112)	857	(123)	870	(126)	820	(152)
Threat Faces	861	(106)	842	(101)	889	(143)	848	(117)

The only effect to emerge was a significant Exposure X Trait Anxiety interaction, F (1, 120) = 6.58, MSE = 2745.78, p = .012, η_p^2 = .052. As can be seen in Figure 6.1, averaged over valence, shock condition and presentation order, the interaction reflects the fact that for the LTA participants' probe classification reaction time was not influenced by the exposure mode, *F* (1, 126) = 2.62, *p* = .108, η_p^2 =.020 *ns*. For the HTA participants however, longer probe classification reaction times were associated with the masked (*M* = 866 msec, *SE* = 14.26) compared to unmasked stimuli (*M* = 854, *SE* = 14.38), *F* (1, 126) = 5.07, *p* =.026, η_p^2 = .039. There were no other significant main effects or interactions, all *F* < 2.74, *p* > .068 *ns*.

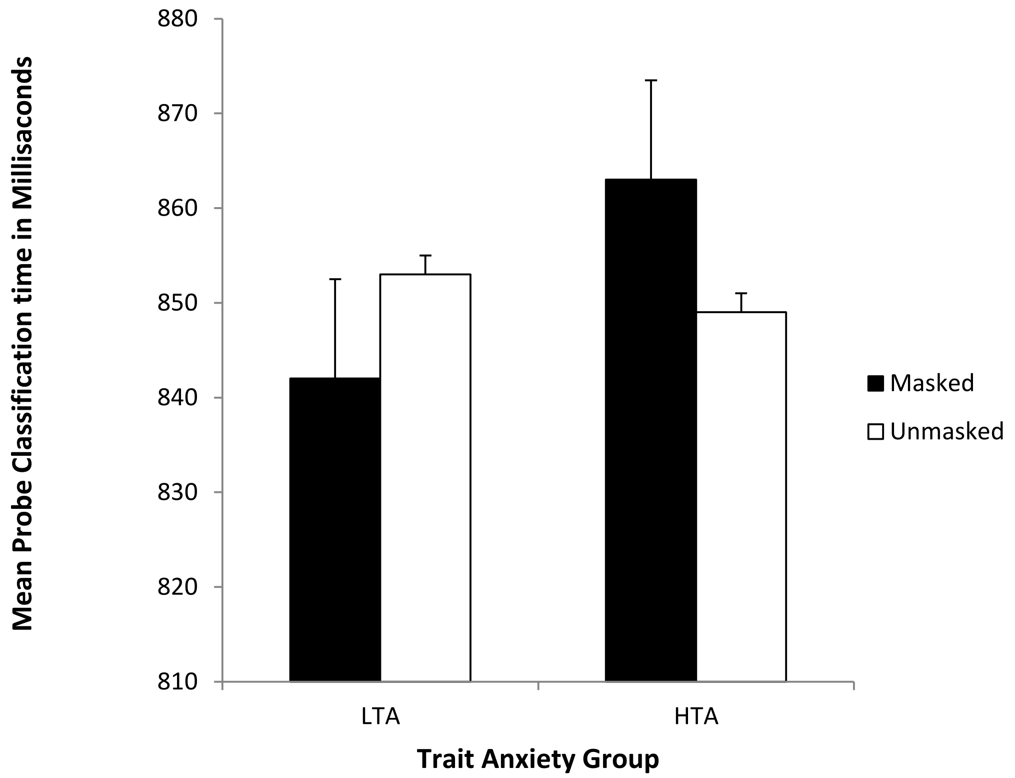

Figure 6.1 .Study 3.1. Mean probe classification reaction times in milliseconds for LTA and HTA groups on masked and unmasked trials, averaged over valence, shock condition and presentation order. Vertical bars represent the standard errors of the mean.

Discussion

The aims of present study were to (1) investigate the role of awareness in selective attention for emotionally toned schematic faces in HTA and LTA participants, and (2) to investigate the role of priming in moderating pre-attentive processing of pictorial threat by presenting masked and unmasked trials blocked on exposure. It was predicted that: (1) if priming is not needed to elicit preconscious threat processing effects, then in line with Clark and Beck (2010), HTA relative to LTA participants would be slower to classify probes that are presented with masked and unmasked threat faces relative to non-threat faces irrespective of whether masked or unmasked trials were presented first but only while performing under the threat of shock. However, if priming is needed, then in line with Öhman (1993) these finding would only emerge when unmasked trials were presented before the masked trials and; (2) if the schematic threat faces do carry more threat value than threat words, then in line with Mogg and Bradley (1998) and Öhman and Mineka (2001) it was predicted that HTA and LTA participants would be slower to classify probes presented with masked and unmasked threat faces relative to neutral or happy faces but only when performing under the threat of shock and only when unmasked trials were presented before the masked trials.

The current study failed to reveal any significant findings, suggesting that on the Flanker task, when the central task is spatially separated from the valenced stimuli, anxiety was not characterized by an automatic attentional bias toward threat. Others employing a similar methodology with pictorial stimuli found that both HTA (e.g., Mogg, Falla & Hamilton, 1998) and LTA participants (e.g., Bradley, Wilson & MacLeod, 2003**)** were vigilant for pictorial threat. The discrepant findings between the current study and those mentioned above could be attributed to the difference in stimuli used, that is, the studies mentioned above employed pictures of human faces as stimuli, whereas the current study employed schematic representations of human faces. It may be that schematic representations of human faces do not carry as much threat value as photographs of human faces depicting angry expressions. Alternatively, the findings may suggest that perhaps intermixing masked and unmasked presentation is necessary to reveal threat processing biases on this task because intermixing primes both masked and unmasked trials.

Alternatively, the lack of significant finding of the present study may suggest that selective threat processing in anxiety does not occur counter to intent. That is, studies employing the dot probe methodology that found evidence for attentional biases to threat as a function of anxiety cannot make predictions on the involuntary nature of this behaviour because the dot probe task is not capable of assessing competition for attention. Furthermore, others (e.g., Putman, Hermans & van Honk, 2004; van Honk, Tuiten, de Haan, van den Hout & Stam , 2001) employing the emotional Stroop colour naming task interference paradigms in an attempt to assess for the involuntary nature of attentional biases to threat in anxiety, have also failed to produce significant findings. These data suggest that attentional biases to pictorial threat in anxiety may not be an involuntary phenomenon.

The present study also failed to find evidence for the “without awareness” component of the automaticity hypothesis. These findings are consistent with Mogg and Bradley (2002) who employed a masked version of the dot probe task with trait and socially anxious participants and found that trait anxious participants did not demonstrate a differential processing of valenced pictures of faces when the stimuli were presented outside of conscious awareness, whereas the socially anxious participants did demonstrate an attentional bias toward threat faces without conscious awareness. These findings may suggest that attentional bias to threat for pictorial stimuli when presented counter to awareness is unique to socially anxious individuals. Perhaps socially anxious individuals are more sensitive to detecting threatening faces because facial features are a vital social signal (Öhman, 1986).

The current data are at discord with Mogg and Bradley (1999a) who presented HTA and LTA participants with masked stimuli followed by unmasked stimuli and found that both groups were vigilant for threat faces when presented counter to awareness. Others (e.g., Lee

& Knight, 2009) presented participants with an intermixed sequence of masked and unmasked trials and also found evidence for vigilance to threat at preconscious levels.

In an attempt to understand the discordant finding all manipulation checks were reviewed. The data confirmed that the HTA group reported significantly more trait anxiety, state anxiety and depression compared to the LTA group. Care was taken to control for depression during statistical analysis on the reaction time data. The findings further revealed that all groups were comparable on age and that shock intensity was comparable between the shock threat groups. State anxiety manipulation was also successful with the shock threat group reporting more nervousness, fearfulness and anxiousness than their shock safe counterparts. Further, given that all participants were exposed to masked stimuli at 15 msec SOA and awareness checks confirmed that participants did not become aware of masked stimuli throughout the experiment, these findings confirm effective experimental control.

In sum, the lack of significant findings in the current study is puzzling. Perhaps when a more ecologically valid paradigm is employed and the stimuli are blocked on exposure the automaticity of selective processing of threat in anxiety is not evident. These data do not provide evidence for the theoretical predictions under investigation. That is, the data did not provide evidence for selective processing of pictorial threat in anxiety. Second, the data did not provide evidence for the automaticity hypothesis proposed by all models described in Chapter 1. That is, the data failed to produce evidence for the involuntary and without awareness component of selective attention to threat in anxiety. The data further failed to provide evidence for the priming hypothesis as proposed by Öhman (1993). In an attempt to further evaluate the role of awareness in selective processing of threat in anxiety, the following study employed masked and unmasked stimuli intermixed.

Study 3.2

Individual Differences in Attention for Intermixed Masked and Unmasked Emotionally Toned Faces in Anxiety with and without the Threat of Shock on the Flanker Task.

The findings of the previous studies employing the emotional Stroop task revealed that, attentional biases for verbal threat were evidenced across all anxiety groups irrespective of state anxiety manipulation, exposure mode and exposure mode presentation order (Study 1). When schematic faces were used as stimuli and masked and unmasked trials were blocked on exposure, HTA participants demonstrated an attentional bias toward masked threat faces irrespective of exposure mode presentation order, but only while performing under shock safe conditions (Study 2.1). However, when masked and unmasked trials were intermixed, the data failed to reveal any significant differential processing of pictorial threat (Study 2.2). When schematic faces were spatially separated from the central task and presented blocked on exposure, the data also failed to reveal any significant threat processing effects (Study 3.1).

Aim of Study

The aim of the present study was to investigate whether threat priming was a necessary precondition to reveal selective processing biases in HTA individuals on tasks in which threat is presented in a task irrelevant region on the visual display. The present study employed the same task and stimuli as study 2.1 but the mode of presentation was such that masked and unmasked trials were presented in an intermixed sequence.

Hypothesis

The present study set out to test the following predictions. In line with Beck and Clark (2010) and Öhman and Mineka (2001) it was predicted that HTA relative to LTA participants would be slower to classify probes presented with masked and unmasked threat faces relative to non-threat faces but only while performing under the threat of shock. However if the schematic threat faces do carry more threat value than threat words than in line with Mogg and Bradley (1998) and Öhman and Mineka (2001), it was predicted that HTA and LTA participants will show similar patterns of threat processing.

Method

Participants

A sample of 114 Bond University students, staff and Gold Coast community volunteers participated in this study. Chapter 3 describe the incentives for participating and screening criteria. Of those who met the initial screening criteria, one participant was excluded due to high depression scores and 10 due to high social desirability scores. They were thanked, given their incentive, a handout detailing the nature of the study, and released. Of those included in the experimental phase, data from a further four participants were excluded. One participant failed to disclose a cardiac condition during the initial screening stage, two were coughing during the experimental procedure, and one participant did not bring their corrective lenses with them to the laboratory. A further 6 participants were excluded due to software failure and data from a further 29 participants was excluded on the basis of their performance on the final awareness check.

Sixty-four participants, 21 males and 43 females, aged 18 years to 65 years (M = 36.59 years; SD = 15.97) made up the final sample. Participants were allocated to a trait anxiety group (32 LTA, 32 HTA) following the same procedure used in Study 1. That is, those who scored 36 and below on the STAI-T were assigned to the LTA group and those who scored 37 and above were assigned to the HTA group. Based on their order of arrival at the laboratory, half of the participants within each trait anxiety group were randomly allocated to either the shock threat or shock safe conditions.

Apparatus

Details for the experimental hardware, software and electric stimulus used in Study 3.2 are discussed in Chapter 3.

Materials

Stimuli. Details on the face, non-face, mask and probe stimuli used in the initial threshold setting trials, practice trials, colour naming trials and final awareness check trials in Study 3.2 are discussed in Chapter 3.

Psychometric Measures

All Participants completed the STAI, BDI, MCSDS and Arousal Rating Questionnaires. Chapter 3 details a description of each questionnaire including, psychometric properties, scoring and inclusion/exclusion criteria.

Design

A 3 X 2 X 2 X 2 mixed design was used for the study. The within subjects factors were valence (happy face vs. neutral face, vs. threat face) and exposure mode (masked vs. unmasked). The between subjects factors were trait anxiety group (HTA vs. LTA) and shock condition (shock threat vs. shock safe). The dependent variables were probe classification reaction times and probe classification errors.

Procedure

All participants provided voluntary informed consent, answered participant eligibility related questions, completed the questionnaires, were assigned to trait anxiety and shock conditions groups prior to completing the SOA threshold setting procedure. Following the

SOA setting procedure, participants allocated to the shock condition underwent the shock intensity setting, all participants then completed the practice trials, experimental trials and the final awareness check trials.

SOA threshold setting. Each participant was required to complete two tasks; a digit classification task and a face-status task were identical to Study 3.1 and governed by the same parameters. In the first block of trials the SOA between the face/non-face and the mask started at 80 msec and was systematically shortened and procedure was in line with parameters employed in Study 2.2.

All odd/even, face/non-face and mask stimuli were quasi-randomized and governed by the following parameters. Six faces and six no faces were presented in a block of 12 trials. The same face type (face vs. non-face) never appeared on more than two consecutive trials. Each of the four masks appeared six times across 24 trials and assigned to each face type twice, but never on more than 2 consecutive trials. On half of the trials within status of the digit was odd and on the other half it was even and the same status never appeared on more than 3 consecutive trials within the block.

Shock intensity setting. In line with Studies 1, 2.1, 2.2 and 3.1, those in the shock threat group underwent a shock intensity setting procedure which was set individually for each participant. See Study 1 for shock intensity setting procedural details.

Practice trials. The procedure and stimuli on the practice trials were the same as those used in Study 3.1 (See Study 3.1 for details).

Probe classification trials. The procedure and stimuli on the probe classification trials in Study 3.2 was consistent with the procedure employed in Study 3.1 with the exception that in the current study, SOA were individually determined during the SOA threshold setting procedure and the unmasked and masked trials were presented intermixed over the four blocks of 24 trials.

Stimulus counterbalancing ensured that the same combination of face, digit, exposure mode and mask did not on more than two consecutive trials. Each face type appeared in each block of 24 trials eight times but never on more than two consecutive trials. Each face type appeared in each block four times masked and four times unmasked. Each mask was presented with each face once in each block. Each mask was presented six times across two blocks of 24 trials and never appeared more than twice with each face type. On half of the trials within each block the status of the digit was odd and on the other half it was even and the same status never appeared on more than four consecutive trials within each block. The status of the digits were counterbalanced with each face type, exposure mode, and probe type and probe position. Each probe type was paired with each face an equal number of times in each exposure mode within the blocks. Probe position and types were counterbalanced across exposure mode and face type within each block of trials and no more than two trials of the same type occurred in succession.

Awareness check trials. Following the completion of the four blocks of experimental probe classification trials, each participant completed a block of 48 awareness check trials. This procedure followed the same parameters as for Study 3.1.

Results

Manipulation Checks

As with studies 1, 2.1, 2.2 and 3.1 validation was sought to confirm that groups differed on trait anxiety and to verify the effectiveness of experimental manipulations prior to statistical analysis of the probe classification reaction time data. See Table 6.6 for person variable details.

Validity of trait anxiety group status. To verify that the HTA and LTA participants significantly differed on self-reported trait anxiety, the STAI-T scores were subjected to a 2 X 2 ANOVA with trait anxiety group (HTA vs. LTA) and shock condition (shock safe vs. shock threat) as the between subject variables and STAI-T scores as the dependent variable. The results revealed a significant main effect of trait anxiety, with the LTA group (*M* = 30.28; *SE* = 0.93) reporting lower trait anxiety than the HTA group (*M* = 44.97; *SE* = 0.93), *F* (1, 60) = 124.17, *MSE* = 27.80, *p* < .001**,** η_p^2 = .647. This main effect was further qualified by a significant Trait Anxiety group X Shock Condition interaction, *F* (1, 60) = 8.37, *MSE* = 27.8, *p* = .005, η_p^2 =.122. The interaction reflected the fact that in the LTA group there was no significant difference in self-reported trait anxiety between the shock safe group (*M* = 29.00; *SD* = 4.08) and the shock threat group (*M* = 31.56; *SD* = 4.73), *F* (1, 30) = 2.46, p = .128, η_p^2= .979 *ns*, in the HTA group, those in the shock safe group (*M* = 47.50; *SD* = 6.35) reported significantly higher trait anxiety than those in the shock threat group (*M* = 42.44; *SD* = 5.30), *F* (1, 30) = 6.00, *MSE* = 34.20, *p* = .020, η_p^2 = .167.

To assess for group differences in self-reported state anxiety, depression, social desirability and age the data were subject to 4 separate 2 X 2 ANOVA with Trait Anxiety Group and Shock Condition as the between subject variables and STAI-S, DASS, MCSDS scores and age of participants as the dependent variables. On the STAI-S measure, a significant main effect of trait anxiety group emerged, with the LTA group (*M* = 25.81; *SE* = 1.27) reporting lower state anxiety than the HTA group (*M* = 38.56; *SE* = 1.27), *F* (1, 60) = 50.10, *MSE* = 51.92, p < .001, η_p^2 =. 455. There were no other main effects or interactions, all *F* < .53, *p* > .469 *ns*.

An analysis of the depression scale of the DASS scores revealed a significant main effect of trait anxiety group, with the LTA group (*M* = 2.25; *SE* = .89) reporting lower depression than the HTA group (*M* = 7.72; *SE* = .89), F (1, 60) = 18.73, *MSE* = 25.55, $p <$ .001, η_p^2 = 238. There was no effect of shock condition and the interaction was not significant, all F < 3.82 *ns*. Further analysis revealed that social desirability as measured by the MCSDS and age of participants were equally distributed among the groups, both $F <$ 1.65, $p > .205$ *ns*. A chi square analysis revealed that gender was proportionately distributed among the anxiety groups, χ^2 (3) = .1.35, $p = .718$ *ns.*

Table 6.6

Study 3.2 Means and Standard Variations for Questionnaire and Age Variables

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Age (years)	36.50	(16.83)	41.00	(15.42)	32.44	(14.78)	36.44	(17.12)
STAI-T	29.00	(4.08)	31.56	(5.11)	47.50	(6.35)	42.44	(5.30)
STAI-S	26.00	(3.27)	25.63	(4.30)	39.69	(7.91)	37.44	(10.76)
DASS-D	2.00	(2.07)	2.50	(4.53)	9.94	(7.33)	5.50	(4.87)
MCSDS	6.63	(1.41)	6.00	(1.90)	7.06	(1.91)	6.75	(2.11)

Validity of state anxiety manipulation. A t-test revealed that the shock intensity for the LTA group (*M* = 18.75 V; *SD* = 23.52) was comparable to the HTA group (*M* = 16.56 V; *SD* = 20.89), $t < 1$ *ns.* The effectiveness of the threat of shock as an anxiety induction method was validated by examining the HTA and LTA participants' responses on the ARQ with and without the threat of shock. Following study 1, 2.1 and 2.2, a single index on each dimension of the ARQ was obtained by averaging nervousness, fearfulness and anxiousness responses over three blocks of trials. Means and SDs of each scale on the ARQ for HTA and LTA groups under the threat of shock and in the shock safe condition are reported in Table 6.7.

Table 6.7

Study 3.2 Means and Standard Deviations of Responses for HTA and LTA Participants on the Nervousness, Fearfulness and Anxiousness Dimensions of the Arousal Rating Questionnaire under Shock Safe and Shock Threat Conditions.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Nervous – Calm	1.45	(1.36)	1.22	(1.41)	0.63	(1.57)	0.20	(1.72)
Fearful - Fearless	1.98	(1.34)	1.47	(1.26)	0.88	(1.52)	0.20	(1.71)
Anxious – Relaxed	1.25	(1.47)	1.23	(1.46)	0.13	(1.39)	-0.14	(1.66)

Note: Negative Scores reflect greater nervousness, fearfulness and anxiety, whereas positive scores reflect the opposite.

Following Study 2.1, The ARQ data was analysed using 2 X 2 ANOVA, with trait anxiety group (LTA vs. HTA) and shock condition (shock safe vs. shock threat) as the between groups factors and the nervousness, fearfulness and anxiousness scores as the dependent variables. For all three dimensions the only significant result to emerge was a main effect of Trait Anxiety. The HTA participants reported more nervousness, (*M* = .41; *SE* = .27), *F* (1, 60) = 5.88, *MSE* = 2.31, *p* = .018, $\eta_p^{2.}$ = .089, fearfulness, participants (*M* = .54; *SE* = .26), *F* (1, 60) = 10.49, *MSE* = 2.15, *p* = .002, η_p^2 = .149 and anxiousness (*M* = .-01; *SE* = .27), *F* (1, 60) = 10.19, *MSE* = 2.24, *p* = .002, η_p^2 = 145 than their LTA counterparts (*M* = 1.34, *SE* = .27; *M* = 1.73, S*E* = .26; *M* = 1.19; *SE* = .27, respectively). There were no other main effects or interactions, all *F* < 1 *ns.*

Validity of masking procedure in preventing awareness. As in Study 2.2, to validate that the SOA on masked trials were comparable between groups, the data were subject to a 2 X 2 ANOVA with anxiety group (LTA vs. HTA) and shock condition (shock safe vs. shock threat) as the between group variable and SOA as the dependent variable. The results revealed comparable SOA between all groups, al *F* < 1 *ns.* See Table 6.8, for SOA means and standard deviation for each group. The groups were comparable on the final awareness check trials and the performance of these groups as a whole (*M* = 23.73; *SD* = 2.62) did not differ from that expected by chance (24; i.e., 50 %), *z* = .10 *ns*. The data suggest that participants were unaware of the stimuli in the masked condition.

Table 6.8

Study 3.2. Means and Standard Deviations of Masked Exposure Duration (msec) and Correct Responses (%) on the Final Awareness Check Trial for HTA and LTA Groups in the Shock Safe and Shock Threat Conditions.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
SOA (msec)	71.25	(12.58)	71.56	(16.71)	72.5	(14.38)	66.56	(21.03)
Correct Responses (%)	48.57	(4.79)	48.70	(6.03)	49.22	(6.22)	51.30	(4.68)

Data Reduction

Prior to statistical analysis the data were reduced in the following stages, (a) microphone failures (1.84 %); (b) probe classification errors (0.75 %); (c) responses less than 300 msec or more than 3000 msec (0.54 %) and; (d) trials more than 2 SD for each individuals cell means (4.72 % of trials) were removed.

Error data. The percentage of errors in each experimental condition is shown in Table 6. 9. Probe classification error data were analysed using a 3 X 2 X 2 X 2 mixed design ANCOVA with valence (happy, neutral and threat faces) and exposure mode (masked vs. unmasked) as the within subject variables and trait anxiety group (LTA vs. HTA) and shock condition (shock safe vs. shock threat) as the between group variables. The depressions scores were entered as the covariate. The errors in probe classification were entered as the dependent variable. The data did not reveal any significant main effects or interactions, all $F < 2.15$, $p > .148$ *ns.*

Table 6.9.

Study 3.2. Means and Standard Deviations of Error Percentages Probe Classification Reaction Times for Masked and Unmasked Happy, Neutral and Threat Faces for HTA and LTA Participants in The Shock Safe and Shock Threat Groups.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	2.73	(5.58)	2.34	(5.04)	2.34	(5.04)	2.34	(5.53)
Neutral Faces	2.34	(3.13)	2.34	(3.87)	3.12	(6.85)	2.34	(5.04)
Threat Faces	1.95	(3.76)	2.34	(4.49)	1.17	(2.52)	0.78	(2.13)
Unmasked								
Happy Faces	2.34	(3.13)	1.95	(4.40)	2.34	(3.87)	2.73	(4.55)
Neutral Faces	2.34	(3.87)	3.52	(5.09)	1.17	(3.40)	2.34	(3.87)
Threat Faces	2.34	(3.87)	4.30	(3.76)	1.56	(3.61)	3.51	(6.83)

Reaction Time Data

Latency data for each experimental condition were calculated and are shown below in Table 6.10. All probe classification latencies were analysed using an equivalent design to that used in the error data.

Table 6.10.

Study 3.2. Means and Standard Deviations for Probe Classification Reaction Times in Milliseconds for Masked and Unmasked Happy, Neutral and Threat Faces for LTA and HTA Participants in the Shock Safe and Threat of Shock Condition.

	Low Trait Anxious				High Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Masked								
Happy Faces	937	(135)	842	(86)	892	(121)	871	(141)
Neutral Faces	954	(151)	843	(84)	902	(140)	853	(154)
Threat Faces	928	(149)	838	(90)	867	(112)	859	(142)
Unmasked								
Happy Faces	890	(117)	831	(81)	862	(108)	869	(157)
Neutral Faces	914	(133)	839	(63)	861	(99)	855	(112)
Threat Faces	912	(113)	824	(99)	870	(102)	853	(137)

The results revealed a significant main effect of Exposure Mode, with longer probe classification reaction times on the masked trials (*M* = 882.12 msec; *SE* = 15.62) than on the unmasked trials (*M* = 865.15 msec; *SE* = 13.38) , *F* (1, 59) = 3.94, *MSE* = 1849.29, *p* = .003, η_p^2 = .144. This main effect was further qualified by a significant Exposure Mode X Shock Condition interaction *F* (1, 59) = 7.06, *MSE* = 1849.29, *p* = 0.010, η_p^2 =.107 and a higher order Exposure Mode X Valence X Shock Condition interaction, *F* (2, 118) = 3.17, *MSE* = 1371.24, p = .046, η_p^2 = .051. To decompose this interaction, the data were collapsed over trait anxiety and analysed separately at each level of exposure mode. As can be seen in the left panel of Figure 6.2, on the unmasked trials there were no significant main effects of valence or shock condition and no interaction involving both variables, all *F* < 1.57 all *p* > .143 *ns*. On the masked trials a significant main effect of valence, *F* (1, 124) = 3.87, *MSE* = 1104.05, *p* = .023, η_p^2 = .059 and a main effect of shock condition, *F* (1, 62) = 4, MSE = 46564.07, *p* = .049, η_p^2 = .061 were qualified by a significant higher order Valence X Shock Condition interaction, *F (*1, 124) =3.67, *MSE* = 1104.05, *p* = .028, η_p^2 = .056. This interaction reflects the fact that there was no difference in probe classification reactions times in the shock threat condition, $F < 1$ *ns*. However, when performing under shock safe conditions different pattern of responding was noted, F (2, 61) = 6.36, $p = .003$, $\eta_p^2 = .172$. A series of repeated measures t tests revealed longer probe classification reaction times for the masked neutral faces (M = 928 msec; SD = 146) compared to the threat faces (M = 897 msec; SD = 133.32), t (31) = 3.38, $p = .002$, with masked happy (M = 914 msec; SD = 128.07) falling between the other two and not differing from either, t (31) = 1.76, $p = .088$ msec or threat faces t (31) = 1.82, $p = .079$ *ns*.

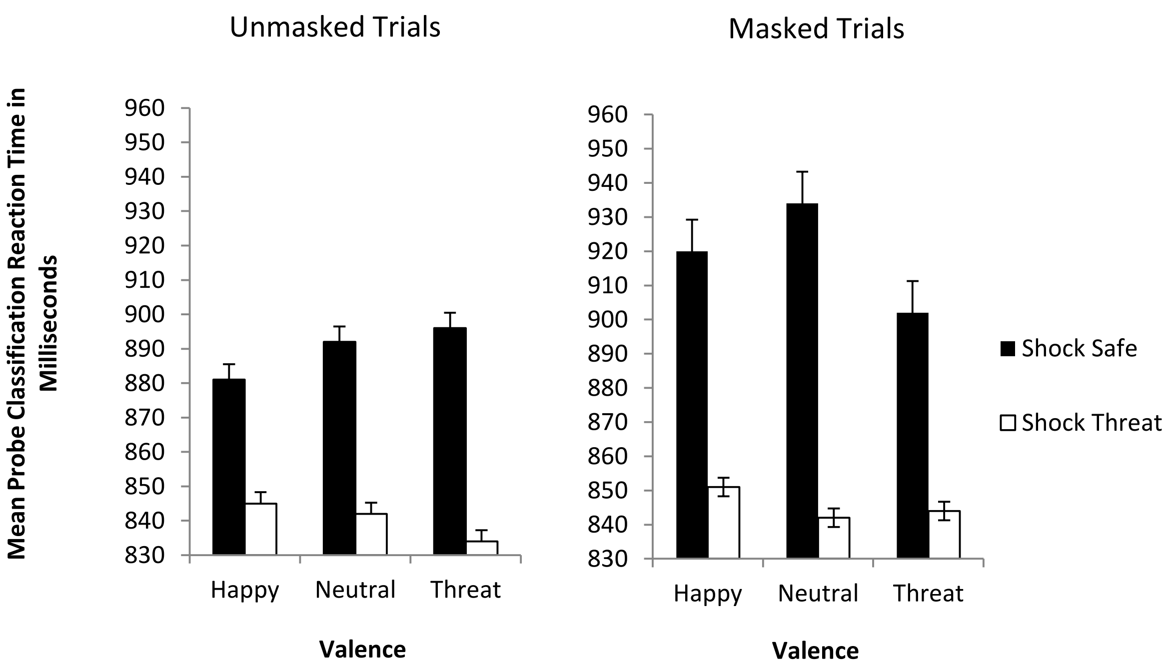

Figure 6.2. Study 3.2. Mean probe classification reaction times in milliseconds for happy, neutral and threat faces in the mask and unmasked exposure mode condition in the shock safe groups and shock threat conditions averaged over trait anxiety. Vertical bars represent standard errors of the mean.

Discussion

The aim of the present study was to investigate whether threat priming was necessary to reveal selective processing biases in anxiety on a task in which threat is presented in a task irrelevant region on the visual display. Consistent with Beck and Clark (2010) and Öhman and Mineka's (2001) theoretical models, it was predicted that HTA relative to LTA participants would be slower to classify probes presented with masked and unmasked threat faces relative to non-threat faces in the shock threat condition. Alternatively, if the schematic threat faces do carry more threat valued than threat words than in line with Mogg and Bradley (1998) and Öhman and Mineka (2001), it was predicted that both anxiety groups would demonstrate this threat processing behaviour.

The data from the present study failed to provide support for the predictions. In the current study, HTA and LTA participants took longer to classify the status of the probe on neutral face trials compared to threat faces. This effect was restricted to when the stimuli were masked, and only when performing under shock safe conditions. Consistent with Study 3.1, these findings are also in opposition to the bias for unmasked threat observed in HTA (Mogg et al., 1998) and masked and unmasked threat processing in LTA participants (Bradley et al., 2003) on the dot probe task .

The lack of significant threat processing biases in the current study and in Study 3.1 may suggest that, attentional bias to threat is only evident when the attended and ignored information are spatially inseparable and this effect is dependent on priming. Furthermore, when employing a task capable of assessing for the involuntary nature of selective processing of pictorial threat, based on the current pattern of data, the finding of Study 3.1, data from van Honk et al. (2001) and Putman, Hermans and van Honk (2004) the findings suggest that attentional biases to threat in trait anxious individuals may not be an involuntary phenomenon and thus inconsistent with the theoretical models under review. In addition, the findings to date suggest that, attentional bias for more ecologically valid threat in anxious individuals does not operate counter to intention.

Further, given that a number of studies found evidence for selective processing of threat faces in socially anxious individuals but not in trait anxious individuals (e.g, Pishyar, Harris & Menzies, 2004; Putman et al., 2004), it may be the case that attentional biases for threat faces is a unique function of social rather than trait anxiety. In summary, the current pattern of data does not provide support for the theoretical models described in Chapter 1.

Chapter 7

General Discussion

The present thesis reported research investigating the selective attention to threatening information in anxiety. In Chapter 1, the theories of Clark and Beck (2010), Mogg and Bradley (1998), and Öhman and Mineka (2001) were discussed. The review evaluated the common predictions made by each model. In summary, all models predicted that (1) anxiety is characterised by an attentional bias for threatening information and (2) attentional bias to threat is automatic in that it is (a) involuntary and (b) occurs outside of conscious awareness. The differences between the models include: (1) the emphasis on the role of awareness in moderating preattentive biases to threat in anxiety; (2) evolutionary relevance and threat value of stimuli (e.g., faces vs. words) and; (3) the emphasis on the influence of state and trait anxiety on moderating the attention bias to threat.

Clark and Beck (2010) suggest that attentional biases favouring threatening information are most prominent in those with a predisposition to anxiety (trait anxiety) whereas, Öhman and Mineka, (2001) propose it is current anxiety (state anxiety) that is most significant factor in predicting this phenomenon. Mogg and Bradley (1998) on the other hand propose a hypothesis that stresses the importance of both trait and state anxiety in moderating selective processing of threat. They propose that with elevated state anxiety, high trait anxious (HTA) individuals will direct their attention toward the source of threat whereas low trait anxious (LTA) individuals will direct their attention away from the source of threat, but only for stimuli evaluated as low in threat value. As for high threat value stimuli, both HTA and LTA individuals are expected to attend toward the source of threat. However, when state anxiety is low, no difference in threat processing is expected between the HTA and LTA individuals.

These models also differ in their emphasis on the role of awareness in activating selective attention toward threatening stimuli in anxious individuals. For example, Öhman (1993) places importance on priming of threat during conscious processes to elicit selective attention at preattentive levels, whereas, Mogg and Bradley (1998) and Clark and Beck (2010) do not specify the need for conscious awareness of stimuli in order to activate attentional biases toward threat that are presented outside of conscious awareness.

Chapter 2 provided a thorough investigation of the empirical literature that has contributed to the development of the theoretical perspectives discussed in Chapter 1. The review identified a number of methodological limitations that did not allow for a complete acceptance of all predictions made by the theoretical models. The methodological limitations identified were as follows: (1) the traditional versions of the dot probe task are unable to investigate whether the attentional bias to threat occurs without volition because these task do not allow for an investigation of competition for attention; (2) the procedures employed to investigate whether attentional bias to threat occurs without awareness were not sufficiently controlled to ensure that participant remained unaware of subliminally presented stimuli nor were they capable of assessing the role of priming in moderating attentional biases to threat at pre-attentive levels; (3) limited studies have employed interference paradigms to assess for the role of awareness in selective processing of pictorial threat and no studies have investigated threat processing on an interference task whereby the to-be-attended-to and to-be-ignored stimuli are spatially separated; (4) the inclusion of clinical studies in assessing the attentional biases to threat as a function of state and trait anxiety were problematic because clinically anxious participants are characterized as being high on both state and trait anxiety; (5) non-clinical studies are capable of investigating the separate effects of state and trait anxiety on moderating the attentional bias to threat but a number of studies failed to manipulate state anxiety in their non-clinical sample and; (6) although not without exception, most researchers have manipulated state anxiety with a future oriented stressor, which is incompatible to the current stress experienced by clinically anxious participants.

To overcome the interpretational limitations associated with the aforementioned methodological concerns, the present thesis included interference paradigms, capable of assessing for both the volitional and awareness components of the automaticity hypothesis. To investigate whether attentional bias to threat occurs without volition, participants were instructed to perform a central task while ignoring distracting information. The extent to which the distracting information interfered with participant's performance on the central tasks, was taken as an index of the extent to which these distractors were capable of recruiting attention counter to intention. To assess whether attentional biases to threat operate outside of conscious awareness, backward masked procedures were employed. To ensure that participants were unaware of content on the masked trials, individual exposure threshold levels were determined prior to the experimental procedure in three studies, and awareness checks were conducted at the end of each experiment to ensure they remained unaware of item content. To ensure that participant's responses on the masked trial were not primed by previous presentations of unmasked stimuli, three of the present series of studies blocked on exposure mode presentation order.

To investigate the separate effects of state anxiety and trait anxiety, a sample of participants varying on trait anxiety levels were included in these studies and state anxiety was manipulated by an immediate threat of an electric shock. The procedures allowed for an investigation of the attentional patterns of clinically anxious, high trait anxious (HTA) under high stress conditions (i.e., threat of shock) and low stress conditions (i.e., no threat of shock) and low trait anxious (LTA) participants under high stress and low stress conditions. To investigate the attentional bias to verbal threat, the study reported in Chapter 4 included threat and non-threat words as stimuli. To investigate the attentional biases to pictorial threat the studies reported in Chapter 5 and Chapter 6 employed schematic representations of emotional (i.e., happy, threat, neutral) faces.

With these procedures in place, 5 studies were conducted to investigate attentional biases for masked and unmasked verbal threat with clinically anxious participants and pictorial threat in non-clinical HTA and LTA participants, half of which performed under treat of electric shock. For each experiment the data were interpreted and discussed in accordance to the theoretical models of attention and anxiety described in Chapter 1. The following section will provided a general discussion of the data for each study with respect to the current empirical literature. The discussion is structured in accordance with the component of the theoretical models under review including any limitations associated with the present series of studies and recommendations for the direction of future research. To conclude, suggestions will be made for treatment consideration of anxiety disorder.

Automaticity: Selective Attention for Threat without Volition and Awareness

An important component of all models described in Chapter 1 is that attentional biases for threat are automatic in that they are (1) involuntary and (2) occurs outside of conscious awareness. The present thesis investigated these components of the automaticity hypothesis. Numerous studies employing dot probe detection ask have suggested that anxious individual selectively attend to threat information (see Chapter 2 for review) as evidenced by spatial allocation of attention to the source of threat. However, these methodologies cannot suggest that this biased attention to threat occurs counter to intention because these methodologies did not employ parameters requiring competition for attention (see Chapter 2 for review). To address these limitations, the current series of studies employed interference paradigms capable of assessing the without volition component of automaticity. These interference paradigms are better suited than the dot probe methodology at addressing this issue because in this methodology participants are instructed to ignore any distracting information while attending to a central task. Thus, attentional bias to threat is a function of the extent to which threat related, relative to non-threat related stimuli interfere or facilitate task performance.

To assess for the second component of the automaticity hypothesis, attentional bias to threat operates without conscious awareness, backward masking procedures were employed. Studies employing backward masking procedures with anxious participants have found that anxiety is characterized by an attentional bias to threat and that this bias occurs outside of conscious awareness. However, given a number of limitations identified with the aforementioned studies, it is unclear whether participants remained unaware of stimuli on masked trials (see Chapter 2).

To ensure that participants remain unaware of all subliminal material, the present studies set conservative (i.e., 15 msec) stimulus onset asynchronies (SOAs) on blocked studies (Study 2.1 and Study 3.1) while individually determined SOAs were employed in Study 1 and on intermixed studies (Study 2.2 and; Study 3.2). To ensure that participants did not become aware of masked content through the experiment, all of the present studies employed awareness check trials, consisting of a lexical decision task (e.g., word/non word) in Study 1, and a conceptually equivalent face status task (i.e., face/non-face) in Study 2.1, Study 2.2, Study 3.1 and Study 3.2 (see Chapter 4 for a description of this task). To ensure the integrity of the data, any participant who exceeded criterion performance on the awareness check trial was excluded. On the basis of these procedures, these studies were able to investigate both the without volition and without awareness component of automaticity.

In the current series of studies, when verbal information was presented unmasked, that is when participants had conscious access to the content. The data revealed that clinically anxious participants and their non-clinical, HTA and LTA, counterparts demonstrated an attention bias for threat words relative to neutral words (Study 1). In this experiment all participants were slower to respond to the central task (e.g., colour naming) in the presence of threatening information (e.g., threat words) relative to neutral information (e.g., neutral words).

When information was presented outside of conscious awareness the findings of a number of studies demonstrated that both clinical and non-clinical individuals will selectively attend to threat relative to non-threat content despite being unaware of the stimuli. For example, the data from Study 1 indicated that clinical and non-clinical participants demonstrated an attentional bias toward threat words relative to neutral words irrespective of whether the words were presented masked first or unmasked first. Similar patterns have been found elsewhere in clinical studies (e.g., Harvey et al., 1996). Study 2.1 also found vigilance for masked threat faces in the HTA group. These results suggest that under some conditions, HTA individuals will demonstrate an attentional bias to subliminal threat. Importantly, these masked effects were observed irrespective of whether masked trials or unmasked trials were presented first. These data suggests that priming is not needed to elicit attentional biases for threat content in conditions that restrict awareness, but are limited to conditions in which the to-be-ignored and to-be-attended to information are spatially inseparable.

These data have a number of significant implications for the theories described in Chapter 1 and for the treatment of anxiety disorders. First, all models propose that anxiety is characterized by an attentional bias for threat and that this bias is automatic in that it is involuntary and occurs outside of conscious awareness. The current data provides mixed support for this prediction. Study 2.2, 3.1 and 3.2 failed to produce any significant support for selective processing of masked or unmasked threat stimuli in either HTA or LTA groups. The data from Study 1 revealed that all participants demonstrated a selective bias to masked and unmasked threat while Study 2.1 only found evidence for masked threat processing, however, these finding were evidenced across all participants. Further, Study 1 and Study 2.1 revealed that priming was not a precursor for eliciting selective processing of threat at preconscious levels. These findings are in opposition to the theory proposed by Öhman (1993) and the findings of Fox (1996) and Edwards et al. (2010b) who suggest that priming is needed to elicit masked effects. Alternatively, the findings of Study 1 and 2.1, are in line with Mogg and Bradley (1999a, Experiment 1 and 3) who found evidence for selective processing of masked threat faces in their control sample (only presented masked trials).

These findings suggest that individuals may attend to threat relevant content when it is presented outside of their conscious awareness irrespective of whether these processes are activated within the cognitive system. However, a limitation of Mogg and Bradley’s (1999a) series of studies is that they employed a dot probe procedure, which cannot assess for the involuntary component of automaticity and they not include an awareness check procedure. Therefore, it is not known whether the participants were unaware of stimulus content on the masked trials. To date, there were no known studies that have employed masked faces on the emotional Stroop task while implementing tight measures to control for awareness, and future research should address this gap in literature. In summary, there is some evidence from two studies (Study 1 and Study 2.1) to suggest that attentional bias to threat is automatic in that it is involuntary and occurs outside of conscious awareness irrespective of whether masked trials or unmasked trials were presented first. However, these findings do not limit this phenomenon to elevated trait anxiety because these findings were observed across all participants.

Unmasked Trials with Verbal Material

Consistent with the theoretical models described in Chapter 1, selective attention for unmasked verbal threat stimuli was evidenced in Study 1. The data however, revealed that vigilance for threat words was evidenced across all anxiety groups (clinical, HTA and LTA) and irrespective of shock conditions (shock threat and shock safe). Although these findings provide support for the predictions made by the models, they are puzzling in several ways. First, verbal stimuli are relatively low in threat value, thus the selective attention for threat words across all anxiety groups is problematic for the theory proposed by Clark and Beck (2010), who place the importance of trait anxiety, Öhman and Mineka (2001), who stress the importance of state anxiety, and for Mogg and Bradley (1998), who propose that for low threat materials, only HTA individuals would demonstrate this effect. Overall, the findings of Study 1 suggests that attentional biases for verbal threat are not moderated by either state or trait anxiety.

Masked Trials with Verbal Material

The data for the masked word trials in Study 1 were at discord with the models under investigation. In Study 1, vigilance for masked threat words was observed across all anxiety groups (clinical, HTA and LTA), and irrespective of shock condition (shock threat and shock safe). Of theoretical importance, the data do not support Öhman's (1993) priming hypothesis which states that the mechanisms responsible for eliciting threat processing at preconscious levels must first be consciously primed. Although these data provide support for the prediction that anxious individuals would demonstrate a preconscious bias toward threat, these data suggest that this bias for masked verbal does not rely on priming to activate the mechanisms responsible for selective processing of threat at preconscious levels and are not restricted to anxious individuals.

Unmasked Trials with Pictorial Material

The data across all studies employing pictorial stimuli (Study 2.1, 2.2, 3.1 and 3.2) did not reveal any significant unmasked threat processing effects and thus, failed to provide evidence for frameworks described in Chapter 1. Given that the emotional Stroop and the flanker task were capable of assessing for competition of resources (both interference tasks) the findings suggest that for selective processing of pictorial threat may not be an involuntary phenomenon. The lack of significant finding on the flanker tasks (Study 3.1 and 3.2) may also suggest that threat biases are not evident when attended to and ignored information are spatially separated.

Masked Trials with Pictorial Material

The theoretical positions investigated in the current thesis propose that attentional biases to threat are automatic in that they occur outside of conscious awareness. One study found support for this prediction. The findings from Study 2.1 revealed that attentional biases to pictorial threat operate at a preconscious level within the cognitive system. In this study, HTA participants demonstrated vigilance toward threat faces while performing under shock safe conditions. These findings hold significant relevance for Öhman's (1993) priming hypotheses. That is, this pattern emerged irrespective of whether masked trials or unmasked trials were presented first, therefore suggesting the phenomenon does not rely on priming. These findings are discordant with Clark and Beck's (2010) model, because processing biases were observed across all participants in Study 1, for Öhman and Mineka's model (2001) because these findings were observed in the low state anxious conditions (Study 1 and 2.1) and for Mogg and Bradley (1998) who place emphasis on both state and trait anxiety in moderating these effects.

Blocked Exposure Presentations vs. Intermixed Exposure Presentations

Öhman (1993) suggests that preconscious threat processing will only occur if the mechanisms responsible for preconscious processing have been primed by way of previous exposure to consciously perceived threat. The data from two studies revealed selective processing of threat effects on blocked presentation modes for masked and unmasked verbal stimuli (Study 1) and masked pictorial stimuli (Study 2.1). The data from Study 1 did not support Öhman's (1993) priming hypothesis because the masked threat processing effects were evidenced irrespective of priming by way of conscious awareness and the verbal stimuli employed in this study were low in threat value and were not evolutionarily prepared. These findings suggest that priming is not a precursor for preconscious processing of threat in anxiety. However, given that both HTA and LTA demonstrated this pattern of responding, the results are inconsistent with the theoretical predictions described in Chapter 1. Further, in Study 2.1 employing pictorial stimuli irrespective of whether masked or unmasked trials were presented first, HTA participants demonstrated attentional biases for masked threat faces, but only while performing under shock safe conditions. These data therefore suggest that priming is not a precursor for selective processing of threat at preattentive levels and are not restricted to anxious individuals.

Verbal Threat Material vs. Pictorial Threat Material

Assessing threat processing for low threat valued stimuli (e.g, threat words) vs. more ecologically valid threat stimuli (e.g, threat faces) is significant for Mogg and Bradley's (1998) model. They propose that with elevated state anxiety HTA individuals will direct their attention toward the source of threat whereas LTA individuals will direct their attention away from the source of threat, but only for stimuli evaluated as low it threat value. As for high threat value stimuli, both HTA and LTA individuals are expected to attend toward the source of threat. However, when state anxiety is low, no difference in threat processing is expected between the HTA and LTA individuals. The findings of the present series of studies provided mixed support for this theory. For example, Study 1 employed words as stimuli and found that all participants irrespective of trait anxiety (i.e., clinical, HTA and LTA) and irrespective of state anxiety (i.e., clinical, high state anxiety and low state anxiety) demonstrated an attentional bias toward both masked and unmasked threat words. For higher threat value stimuli (i.e., faces) only HTA participants demonstrated an attentional bias toward masked threat faces under low stress conditions (Study 2.1). These findings are similar to those observed by Mogg et al., 1999a). No significant threat processing biases were observed in Study 2.2, 3.1 and 3.2. The limited masked effects and failure to find unmasked effects for pictorial threat stimuli are in line with one other study (e.g., van Honk, Tuiten, de Haan et al., 2001).

Spatially Integrated vs Spatially Separated Stimuli

Only two (Study 1 and Study 2.1) of the five studies reported here found evidence for selective processing of threat stimuli. Study 1 and 2.1 employed the emotional Stroop task and blocked on mode of exposure. On this task, the attended to and ignored information were spatially integrated. The studies differed in a number of ways. Study 1 employed words as stimuli and individually determined SOA, whereas Study 2.1 employed schematic faces as stimuli and SOAs were set at 15msec. The findings also differed in a number of ways. First, in Study 1, selective processing for verbal threat was observed across all anxiety groups, irrespective of state anxiety manipulation and exposure mode, whereas in study 2.1 these findings were only observed for HTA individuals on masked trials while performing under shock safe conditions. Given that all other variables were held constant across both studies, the differences in findings can be attributed to the stimuli employed and/or SOAs. Of central importance, the failure two produce significant threat processing biases in study 3.1 and 3.2, may suggest that attentional bias to threat is only evident when attended and ignored stimuli are spatially integrated. The findings may also suggest that when stimuli are spatially separated, selective attention for pictorial threat in anxiety is not an involuntary phenomenon.

Clinical vs. Non-Clinical HTA and LTA

Study 1 found evidence for selective processing of masked and unmasked threat words across all clinical and non-clinical HTA and LTA participants. However, these findings were not moderated by either state or trait anxiety and therefore are at odds with the theoretical models under review. These findings suggest that, when the to-be-ignored and to-be-attended to stimuli are spatially integrated, selective processing of verbal threat associated wiht both clinical and non-clinical samples. Study 2.1, employing the emotional Stroop task with more ecological valid stimuli (schematic faces), the data revealed evidence for selective processing of masked threat faces in non-clinical, HTA participants but only under low stress conditions (shock safe). These findings therefore do not support the Öhman and Mineka's (2001) model, which stress the importance of elevated state anxiety in eliciting these effects. These findings are in accord with Clark and Beck's (2010) model.

Limitations and Directions for Future Research

A number of limitations were noted with the current series of studies that can prove difficult for generalization to real world applications and for comparison with previous findings. First, the current series of studies employing pictorial stimuli were not identically representative of human faces but rather a schematic representation and therefore, these findings cannot generalize to the attentive processes toward more biologically prepared stimuli (i.e., photographs of human faces). Nonetheless, according to Öhman, Ludvist and Esteves (2001) these stimuli are better suited to overcome a number of limitations associated with using words as stimuli and photographic pictures of human faces. Moreover, given that a number of studies found evidence for selective processing of threat faces in socially anxious individuals but not in trait anxious individuals (e.g, Pishyar, Harris & Menzies, 2004), it may be that attentional biases for threat faces is a function of social rather than trait anxiety and thus it may be useful to employ assessment protocols to aid in data analysis.

A further limitation is related to the methodology employed. As noted in Chapter 1, the emotional Stroop task is not without limitations particularly in terms of the unknown nature of the mechanisms that underlie the Stroop effect. For example, Mogg and Bradley (1998) suggest that this task does not discriminate between the encoding bias and the response bias, whereas the interference for colour naming has been suggested to be a result of participants trying to ignore the semantic content of stimuli (e.g. MacLeod, 1996). Despite these possibilities, similar patterns of threat processing have been noted across other experimental paradigms such as the visual search (e.g., Rinck, Becker, Kellerman, Walton & Roth, 2003), spatial cueing (e.g., Amir, Elias, Klumpp & Przewroski, 2003) and dot probe tasks (e.g., Amir, Najmi & Morrison, 2009). Nonetheless, the importance of the emotional Stoop paradigm is that it allows for assessment of the extent to which attentional biases occur counter to intention.

Implication for the Treatment of Anxiety Disorders

The models described in Chapter 1, suggest that attentional biases for threat may be attributed to the maintenance of anxious pathology and others (e.g., Mathews, Mogg, Kentish, & Eysenck, 1995; Mogg, Bradley, Miller & White, 1995) suggest that anxious individuals who demonstrated these attentional patterns prior to treatment do not display them once recovered after treatment. Therefore, if anxious pathology is characterized by an attentional bias toward threatening information then treatment interventions should focus on therapeutic strategies that are capable of targeting these behaviours.

A difficulty with developing treatment strategies that can account for restructuring these selective threat biases is that they are suggested to occur automatically in that they are involuntary and occur outside of conscious awareness (e.g., Study 1, Study 2.1; see for review, e.g., Bar-Haim et al, 2007; Cisler & Koster, 2010; Cisler, Bacon & Williams, 2009; Mogg & Bradley, 1998). Therefore traditional therapies that employ consciously moderated strategies would not be able to intervene in such processes. Importantly, the data reported in Study 1 and Study 2.1 confirm that priming is not a necessary precondition for these biases to emerge, and further confirm the encapsulated nature of the phenomenon why anxiety is often insensitive to verbally mediated therapeutic strategies. However, Mogg and Bradley (1998) suggest that the mechanisms responsible for threat appraisal may be moderated by individual differences in trait anxiety. On the basis of their model, individuals with anxious traits are seen to demonstrate a vigilance-avoidance pattern in attending to threat. That is, individuals may initially attend to the source of threat but then apply coping strategies that result in the avoidance of that threat. When taking this into account, the attentional bias patterns may be intervened by exposure therapies. That is, training individuals to experience any anxiety provoking situations or events in an attempt to deploy the association of the stimulus and the anxious response. On a further note, because some of these attentional biases do not appear to be restricted to processes that are presented counter to awareness, cognitive behavioural therapies appear to be a valid intervention strategy because individual can be trained to modify their cognitive distortions in the presence of anxious triggers (Fox, 1996) which is an effective method in the treatment of anxiety disorders (Salkoviskis, Clark & Hackmann, 1996) and the removal of preattentive bias effects (Mogg et al 1995).

Summary and Conclusions

This research has provided a number of observations that are summarized as follows: (1) clinically anxious and non-clinical HTA and LTA individuals demonstrate vigilance for verbal threat that is presented within and outside of conscious awareness, (2) similarly, HTA and LTA individuals demonstrate vigilance for verbal threat irrespective of state anxiety, (3) under some conditions, when more ecologically valid stimuli are introduced, HTA but not LTA individuals will selectively attend to threat that is presented outside of their conscious awareness but only when performing under low stress conditions; (4) vigilance for threat is not evident when to be ignored and to be attended to stimuli are spatially separated; (5) priming is not a necessary precondition for eliciting attentional biases for subliminal threat. These data suggest anxiety may be characterized by a maladaptive attention pattern for mild and more biologically relevant threat. Of importance, because there is some evidence to suggest that these attentional patterns occur both within and outside of conscious awareness, cognitive therapies involving verbally moderated strategies may be appropriate for the intervention of the behaviours that appear to underpin anxious pathology.

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Appendices

Appendix A

The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961)

This questionnaire consists of 21 groups of statements. After reading each group of statements carefully, circle the number (0, 1, 2 or 3) next to the one statement in each group that best describes the way that you have been feeling the **past week, including today**. If several statements within a group seem to apply equally well, circle each one. **Be sure to read all of the statements in each group before making your choice**.

1	0	I do not feel sad
	1	I feel sad
	2	I am sad all of the time and I can't snap out of it
	3	I am so sad or unhappy that I can't stand it
2	0	I am not particularly discouraged about the future
	1	I feel discouraged about the future
	2	I feel I have nothing to look forward to
	3	I feel the future is hopeless and that things cannot improve
3	0	I do not feel like a failure
	1	I feel I have failed more than the average person
	2	As I look back on my life, all I can see is a lot of failures
	3	I feel I am a complete failure as a person
4	0	I get as much satisfaction out of things as I used to
	1	I don't enjoy things the way I used to
	2	I don't get any real satisfaction out of anything anymore
	3	I am dissatisfied or bored with everything
5	0	I don't feel particularly guilty
	1	I feel guilty a good part of the time
	2	I feel quite guilty most of the time
	3	I feel guilty all of the time
6	0	I don't feel I am being punished
	1	I feel I may be punished
	2	I expect to be punished
	3	I feel I am being punished
7	0	I don't feel disappointed in myself
	1	I am disappointed in myself
	2	I am disgusted with myself
	3	I hate myself
8	0	I don't feel I am any worse than anybody else
	1	I am critical of myself for my weaknesses or mistakes
	2	I blame myself all the time for my faults
	3	I blame myself for everything bad that happens
9	0	I don't have thoughts of killing myself
	1	I have thoughts of killing myself, but would not carry them out
	2	I would like to kill myself
	3	I would kill myself if I had the chance
10	0	I don't cry any more than usual
	1	I cry more now than I used to
	2	I cry all the time now
	3	I used to be able to cry, but I can't even though I really want to

11	0 1 2 3	I am no more irritated now than I ever am I get annoyed or irritated more easily than I used to I feel irritated all the time now I don't get irritated at all by the things that used to irritate me
12	0 1 2 3	I have not lost interest in other people I am less interested in other people than I used to be I have lost most of my interest in other people I have lost all of my interest in other people
13	0 1 2 3	I make decisions about as well as I ever could I put off making decisions more than I used to I have greater difficulty in making decisions than before I can't make decisions at all any more
14	0 1 2 3	I don't feel I look any worse than I used to I am worried that I am looking old or unattractive I feel there are some permanent changes in my appearance that make me look unattractive I believe that I look ugly
15	0 1 2 3	I can work about as well as before It takes extra effort to get started at doing something I have to push myself very hard to do anything I can't do any work at all
16	0 1 2 3	I can sleep as well as usual I don't sleep as well as I used to I wake up 1-2 hours earlier than usual and find it hard to get back to sleep I wake up several hours earlier than I used to and can't get back to sleep
17	0 1 2 3	I don't get any more tired than usual I get tired more easily than I used to I get tired from doing almost anything I am too tired to do anything
18	0 1 2 3	My appetite is no worse than usual My appetite is not as good as it used to be My appetite is much worse now I have no appetite at all anymore
19	0 1 2 3	I haven't lost much weight, if any, lately I have lost more than 2½ kilograms (5 pounds) I have lost more than 5 kilograms (10 pounds) I have lost more than 7½ kilograms (15 pounds)
20	0 1 2 3	I am no more worried about my health than usual I am worried about physical problems such as aches and pains; upset stomach; constipation I am very worried about physical problems and it is hard to think of much else I am so worried about my physical problems that I cannot think about anything else
21	0 1 2 3	I have not noticed any recent change in my interest in sex I am less interested in sex than I used to be I am much less interested in sex now I have lost my interest in sex completely

Appendix B

The Depression Anxiety and Stress Scale (DASS; Lovibond & Lovibond, 1995)

DASS21 *Name:* *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (e.g., in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

Appendix C1

State Trait Anxiety Inventory – Form Y1

(STAI-S; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983).

A number of statements that people have used to describe themselves are given below. Read each statement carefully and then circle the appropriate number to the right of the statement to indicate how you feel **right now**, that is, **at this moment**. The scoring key is indicated below. There are no right or wrong answers. Do not spend much time on any one statement but give the answer that seems to describe **your current feelings** best.

Not at all	Almost Never	Very Much So	Almost Always
1	2	3	4

1	I feel calm	1	2	3	4
2	I feel secure	1	2	3	4
3	I am tense	1	2	3	4
4	I feel strained	1	2	3	4
5	I feel at ease	1	2	3	4
6	I feel upset	1	2	3	4
7	I am presently worried over possible misfortunes	1	2	3	4
8	I feel satisfied	1	2	3	4
9	I feel frightened	1	2	3	4
10	I feel comfortable	1	2	3	4
11	I feel self-confident	1	2	3	4
12	I feel nervous	1	2	3	4
13	I am jittery	1	2	3	4
14	I feel indecisive	1	2	3	4
15	I am relaxed	1	2	3	4
16	I feel content	1	2	3	4
17	I am worried	1	2	3	4
18	I feel confused	1	2	3	4
19	I feel steady	1	2	3	4
20	I feel pleasant	1	2	3	4

Appendix C2

State Trait Anxiety Inventory – Form Y2

(STAI-T; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983).

A number of statements that people have used to describe themselves are given below. Read each statement carefully and then circle the appropriate number to the right of the statement to indicate how you **generally** feel. The scoring key is indicated below. There are no right or wrong answers. Do not spend much time on any one statement but give the answer that seems to describe how you **generally** feel.

		Almost never	Sometimes	Often	Almost always
		1	2	3	4
21	I feel pleasant	1	2	3	4
22	I feel nervous and restless	1	2	3	4
23	I feel satisfied with myself	1	2	3	4
24	I wish I could be as happy as others seem to be	1	2	3	4
25	I feel like a failure	1	2	3	4
26	I feel rested	1	2	3	4
27	I am “calm, cool and collected”	1	2	3	4
28	I feel that difficulties are piling up so that I cannot overcome them	1	2	3	4
29	I worry too much over something that does not really matter	1	2	3	4
30	I am happy	1	2	3	4
31	I have disturbing thoughts	1	2	3	4
32	I lack self-confidence	1	2	3	4
33	I feel secure	1	2	3	4
34	I make decisions easily	1	2	3	4
35	I feel inadequate	1	2	3	4
36	I am content	1	2	3	4
37	Some unimportant thought runs through my mind and bothers me	1	2	3	4
38	I take disappointments so keenly that I can’t put them out of my mind	1	2	3	4
39	I am a steady person	1	2	3	4
40	I get in a state of tension or turmoil as I think over my recent concerns or interests	1	2	3	4

Appendix D

Marlowe-Crowne Social Desirability Scale – Form XI

(MCSDS – Form XI; Marlowe & Crowne, 1960; Strahan & Gerbasi, 1972).

Listed below are a series of statements that may or may not apply to you. It is important that you **read the statements carefully**. If you believe that the statement applies to you, then circle **T** for **TRUE**. Alternatively if you feel that the statement has **never** applied to you, then circle **F** for **FALSE**.

		True	False
16	I am always willing to admit it when I make a mistake	**T**	**F**
17	I always try to practice what I preach	**T**	**F**
25	I never resent being asked to return a favour	**T**	**F**
26	I have never been irked when people expressed ideas very different from my own	**T**	**F**
33	I have never deliberately said something to hurt someone's feelings	**T**	**F**
11	I like to gossip at times	**T**	**F**
15	There have been occasions when I took advantage of someone	**T**	**F**
19	I sometimes try to get even rather than forgive and forget	**T**	**F**
22	At times I have really insisted on having things my own way	**T**	**F**
23	There have been occasions when I have really felt like smashing things	**T**	**F**

Appendix E

Arousal Rating Questionnaire

1. Right now, at this moment, I feel:

	very	quite	slightly	neither/nor	slightly	quite	very	
Nervous	3	2	1	0	1	2	3	Calm
Fearful	3	2	1	0	1	2	3	Fearless
Anxious	3	2	1	0	1	2	3	Relaxed